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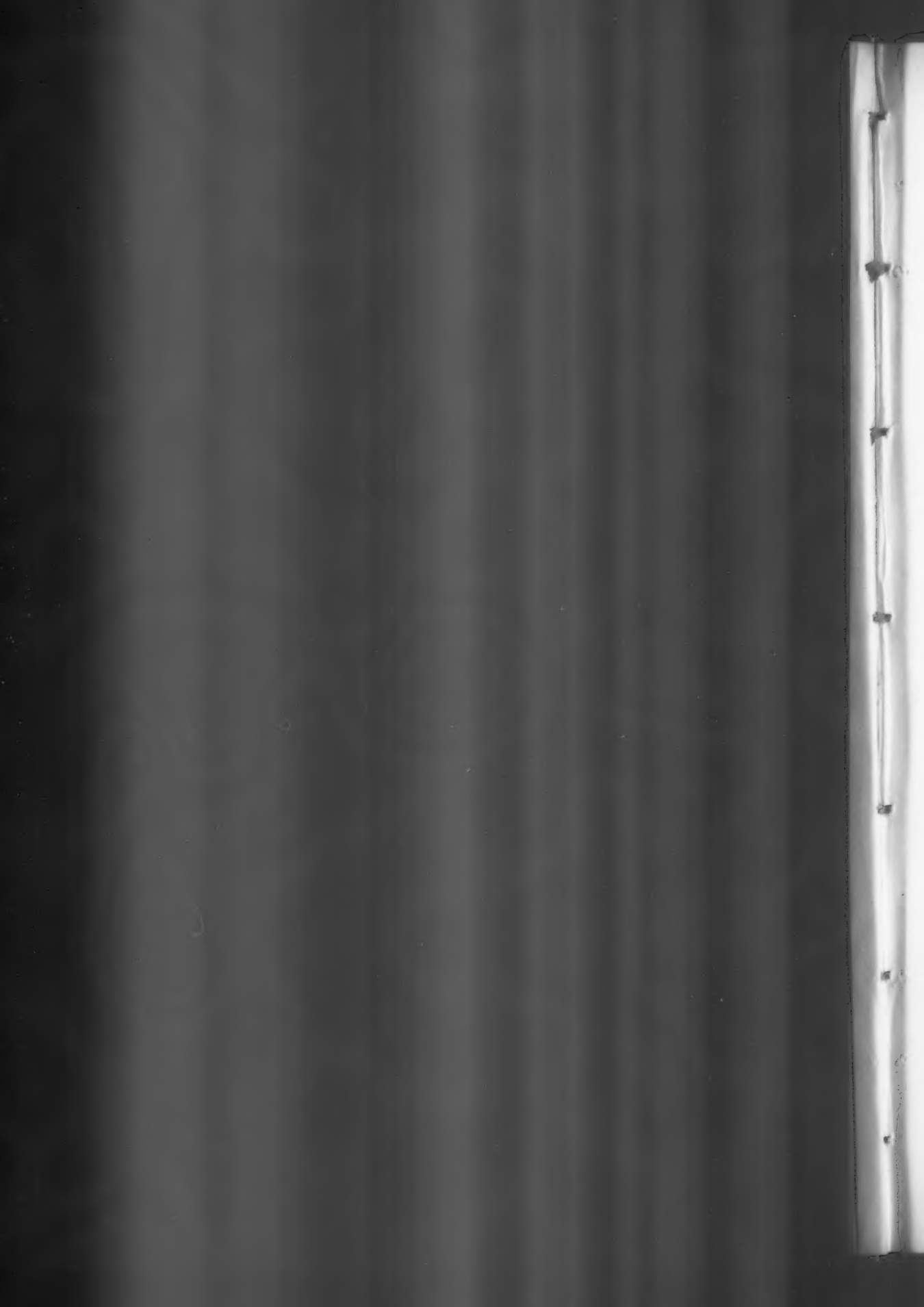


MUNICIPAL ENGINEERING

VOLUME XXVIII APRIL, NINETEEN HUNDRED FIVE NUMBER FOUR

SEWAGE PURIFICATION PLANTS IN OHIO.

The eighteenth annual report of the State Board of Health of Ohio contains a report of an examination of the sewage purification plants in the State. The information was collected by the late Mr. B. H. Flynn, and the report is made by his successor, R. Winthrop Pratt. We are indebted to Dr. C. O. Probst, the Secretary of the Board, for the accompanying illustrations of some of the plants.

The first plant built in the State was the Canton chemical precipitation plant, which was completed in 1893. The writer of this article visited the plant in 1894 and, except for increase in amount of sewage and consequent increase in difficulty of disposing of sludge, the description of the operation and condition of the plant is very nearly the same at the present time that it was eleven years ago.

The city has now 32,500 population and a water consumption of 112 gallons per capita, or 2,828,000 gallons a day. The total sewage flow at the works is from 2,000,000 to 2,500,000 gallons a day, fifty per cent. of which is ground water from the outlet sewer below the last sewer connection. There are 33.74 miles of sewers and 2,144 connections, serving about one-third of the population. By actual measurement the flow through the sewage works was 100 gallons per person connected per day in 1893. It is now more than 200 gallons.

The accompanying photograph, Plate I, shows the building, 35 by 60 feet, in which the boiler, pumps, mixer and sludge press are located, the second floor having storage room for chemicals. The view is taken across the four settling tanks, two showing clearly and the other two being to the left, opposite the building and adjacent to the other two, with the channels feeding sewage to the four running between the two pairs. Each tank is 50 by 100 feet, with 5 feet depth of water, increased at will by stop planks. The capacity of the tanks is 700,000 gallons or one-third the daily flow, and each of the first two tanks is drained three times a week, and the other two once a week. As this process of cleaning takes several hours, the rate of flow of sewage through the tanks is more rapid than that indicated.

Lime only is used as precipitant, 980 pounds, or 14 bushels, at 12 cents a bushel, being used each day. The amount of lime is less per gallon than formerly, and the use of alum has been discontinued on account of expense, but without serious effect on the efficiency of the plant.

The plant cost $31,545, of which $5,000 was for land. The cost of operation is: three men, one at night, $2,000; lime, $550; fuel, $600; repairs, etc., $600; total, $3,800.

The plant is successful in reducing the visible pollution of the creek, and produces no nuisance. The amount of sludge is increasing beyond capacity of sludge press and land, and it may soon be necessary to press it and burn it in the adjacent garbage cremation plant.

Another chemical precipitation plant is that at Alliance, completed in 1896, and serving 14.5 miles of sewers with 844 connections and about 4,000 of the people in the city, with 500,000 gallons average daily flow. Two large iron-working factories and a gas works discharge into the sewers.

The accompanying view, Plate II, shows the building, 60 by 30, and the three settling tanks, each 40 by 80 by 6 feet, with 140,000 gallons capacity, or a total of about 82 per cent of the daily flow. The first two tanks being cleaned twice a week and the third once, the relative reduction in capacity is greater than at Canton on this account.

Lime only is used now as precipitant, about 18 bushels a day, but not continuously. The sludge is pressed and dumped on the creek bank, about 2 tons a day,

and produces the only nuisance about the plant. The gas works waste interferes with the action of the tanks, and also the sludge press. In September, 1904, the plant was doing very poor work, and there were many complaints of pollution of the stream and odors at the works.

The cost of the plant was $22,200, and operating expenses are $2,014 a year; for two men, $960; fuel, $367; lime, 14 bushels at 15 cents, $766.50.

Chemical precipitation tanks are in use also at Glenville.

The accompanying drawing, Plate III, shows the plans for the new filtration plant of the Fairmount Children's Home at Alliance, which has a population of about 175. A sub-surface disposal system failed after two years by filling up the distribution pipes and on account of unsuitable soil. A sedimentation tank, acting partly as a septic tank, with contact beds and filters, also failed, apparently on account of defects in design. The present plant was built in 1903 and consists of four sand filters, each 50 feet square, a total of 0.23 acre, for 15,000 gallons of sewage a day. After screening, the sewage flows to a 2,400 gallon dosing tank which discharges through two dosing pipes alternately on the two pairs of beds as shown in the drawing, each discharge covering a bed 1.5 inches deep.

There is 4.3 feet of filtering material over the underdrain and 3.7 feet at the sides of the bed. The main underdrain runs under all four beds at a gradient such that water drained from one bed will not affect another. On top of this pipe is about 6 inches of broken stone or gravel, and above this clean sharp sand. The beds worked well until freezing weather, but the action in winter is not reported upon. The cost was $6,000, mainly for filtering material, and the maintenance thus far is the cost of about one hour's work a day.

Clyde, with 2,600 population, uses four acres of filter beds for 100,000 gallons of dry weather flow and flooded beds in wet weather, with no attempt at purification from December to April. The beds are not kept clean and do not work well, and become nuisances when waste from a sauerkraut factory is added to the other sewage. The overdosing of beds by storm water is very injurious. The plant cost $5,000, including 23 acres of land, and the annual cost is $250.

Plate IV shows four of the filter beds of the Montgomery County Infirmary, near Dayton. Four similar beds are on the other side of the embankment on the left. The institution has a population of 400 and about 25,000 gallons of sewage a day. A flush tank of 12,000 gallons' capa-

I. CHEMICAL PRECIPITATION PLANT AT CANTON, O.

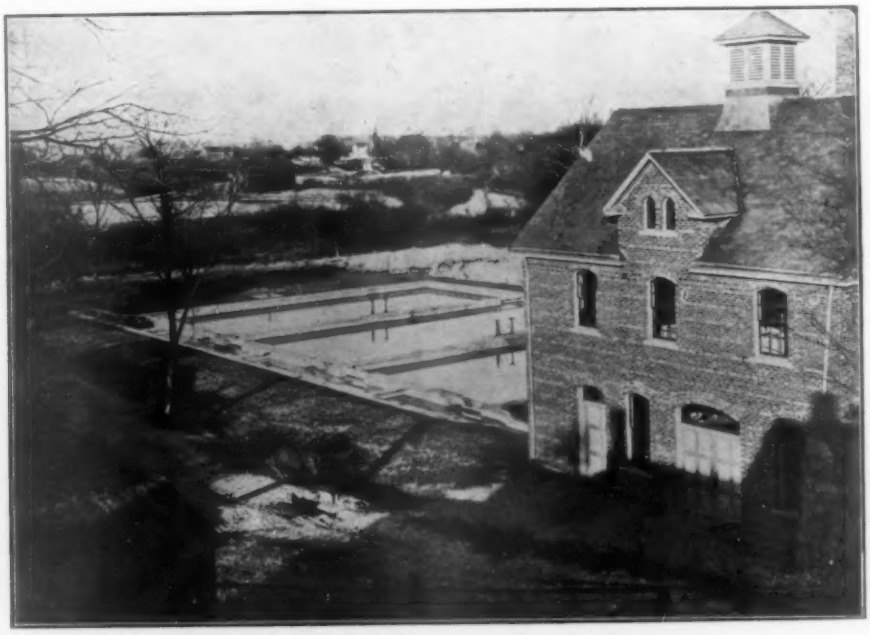
city receives the screened sewage and discharges it automatically in about ten minutes twice a day on each bed in turn, so that each of the eight beds receives a dose about once in four days, and is then flooded about eight inches deep. This amounts to 50,000 gallons per day. Across the center of each bed, as shown in the picture, is a line of half tiles diminishing from twelve to four inches, with openings at each change in size to permit the sewage to flow out over a stone surface onto the bed. Except in the winter the beds are thoroughly scraped after each dose, the scrapings being used as a fertilizer. A smaller dose of sewage would reduce the amount of scraping probably in greater proportions. This frequent cleaning reduces the efficiency of the bed somewhat, but the effluent is clear and causes no nuisance.

The plant cost $6,000 and the annual cost is one man's wages, about $450 a year.

Fostoria uses intermittent filtration beds, with some broad irrigation as an adjunct, the sewage first being settled and screened. The soil is not favorable and the beds are not properly cleaned, but the effluent shows some purification, is clear and produces no nuisance.

The Ohio Hospital at Gallipolis, uses two similar systems, one for each of two departments, with somewhat better results. The same may be said of the State Hospital at Massillon. The Toledo State Hospital has a less efficient system which it does not use all the year.

The system at Shepardson's College, Granville, for about 100 persons, was designed for intermittent filtration, but is operated as a broad irrigation field. It does not purify the sewage, and the small proportion of sewage to area irrigated is the only reason that nuisance is not created.

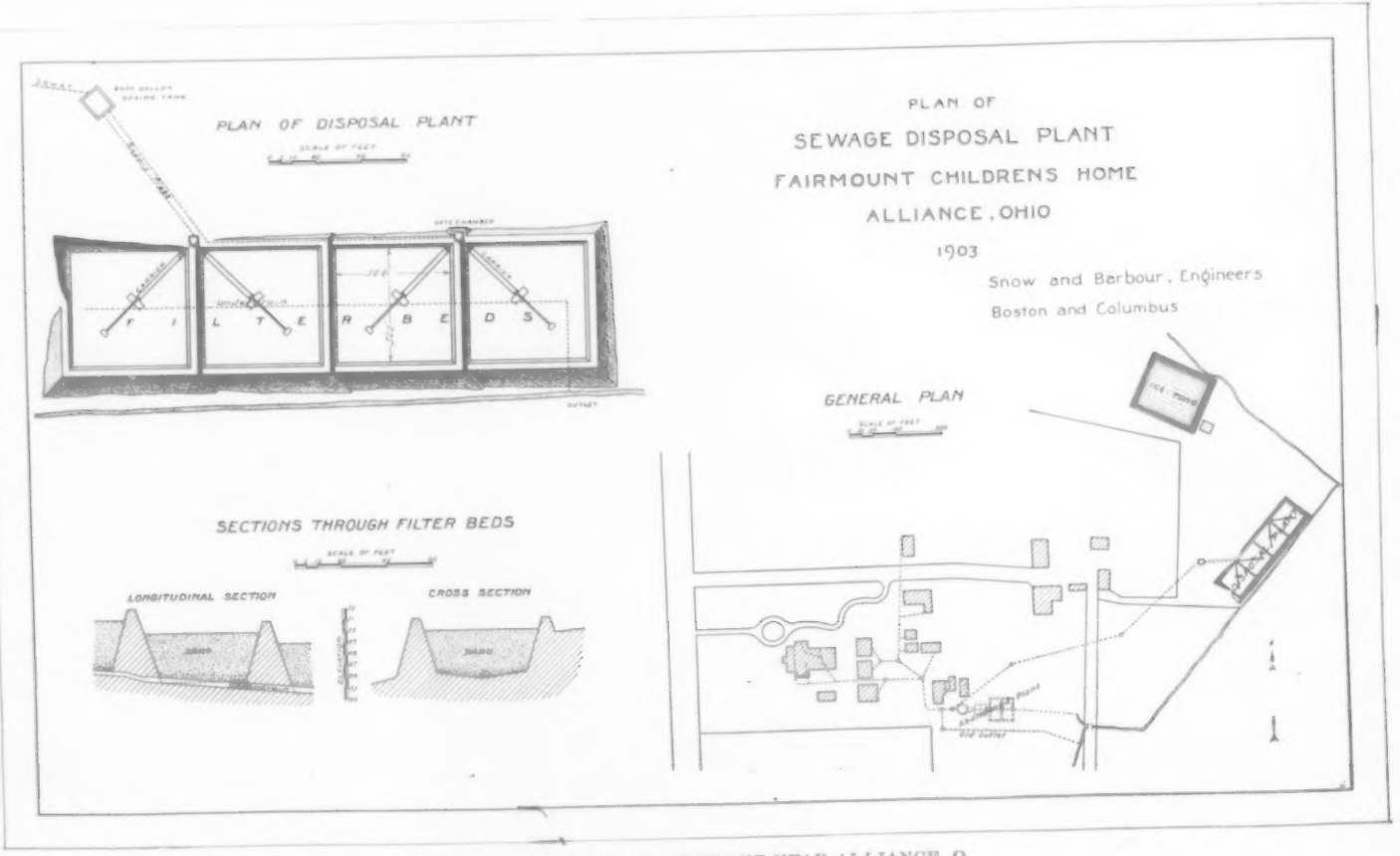


H. CHEMICAL PRECIPITATION PLANT AT ALLIANCE, O.

The Boys' Industrial School, near Lancaster, uses intermittent filtration beds, twenty-five in number, and 43 feet by 60 to 100 feet in plan, in all about two acres for 1,000 inmates. It is well taken care of except as to inequality of distribution of sewage over beds, and produces good results.

The Ohio State Reformatory has 1.1 acres of intermittent filtration beds for 600 to 700 people, discharging 100 gallons of sewage each. With somewhat better attention, it should do good work at all times.

Oberlin tried intermittent filtration and



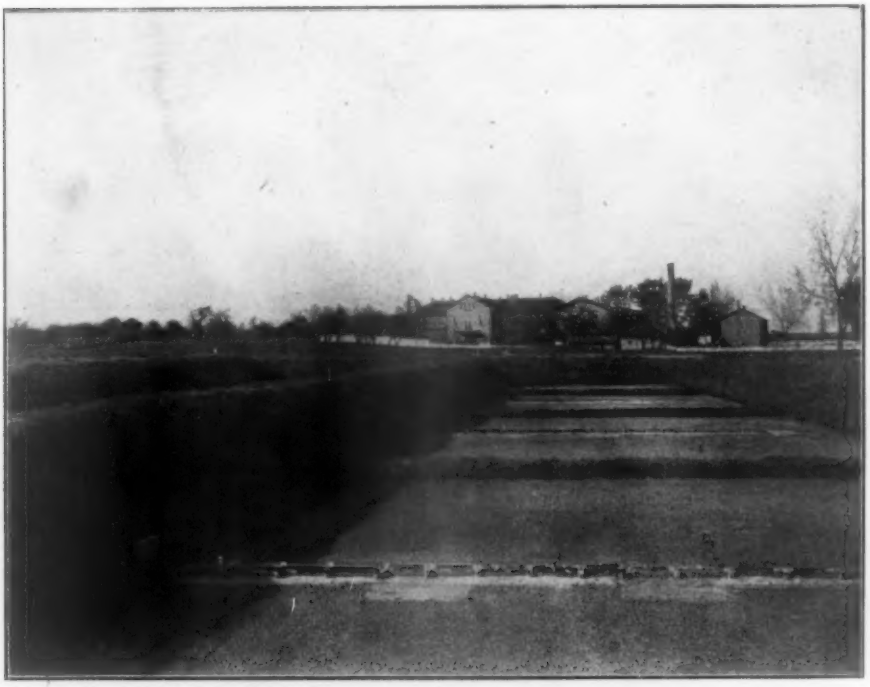
III. SEWAGE FILTRATION PLANT NEAR ALLIANCE, O.

broad irrigation after settlement, but when the land became overloaded treatment with sulphate of alumina was added. The plant did good work until it was overburdened.

Shelby has settling tanks of sufficient capacity to serve as septic tanks if the iron and acid waste from the tube works did not act as a chemical precipitant. This sewage flows to a reservoir holding five days' sewage, and thence to the filter beds, which are 0.6 acre in extent and require little attention since the use of the reservoir began. Cinders in the beds disintegrate. The effluent turns brownish in the creek in consequence of the iron in it.

The last two plates, V and VI, show views of the septic tanks and contact filters of the Kenton north district, which serve at present about 400 people, treating a day flow at the rate of 35,000 gallons, or probably an average of 25,000 gallons in twenty-four hours.

The septic tank is in the building, is 28 feet by 16 and 6 feet deep, holding 21,000 gallons or about one day's dry weather flow. There are three dosing or contact filters, which are flush tanks filled with coarse filtering material, into which the septic tank discharges. These flush tanks and their siphons are seen outside the building in Plate V, and the man is standing on their outside wall in Plate VI. The flush tanks are 5 by 10 feet and 2 feet deep, and are filled with charcoal, coke, and limestone of one to three inch size. Elevation of the outlet pipe puts a tank out of operation. These tanks discharge automatically, each on its own filter bed, as shown especially in Plate VI. The bottoms of these beds slope away from the tanks and they are filled with pea coke eighteen inches deep at the upper end at four inches at the lower, with a layer of broken stone on top. These filters are each 10 by 100 feet and the sewage flows their entire length to an effluent channel.



IV. SEWAGE FILTRATION PLANT NEAR DAYTON, O.

The septic tank contained only a foot of sludge after one and one-half years of operation, and has no scum except when surface water enters, there being one or two catch basins connected with the otherwise separate system of sewers. The scum disappears when the effect of the surface water has passed. The dosing filters are liable to clog around the air pipe of the siphon and cause continuous

V. SEPTIC TANK AND ROUGH FILTER AT KENTON, O.

VI. SEPTIC TANK AND CONTACT BIDS AT KENTON, O.

discharge. One man inspects the siphons three or four times a month and loosens the material at the upper ends of the filters at an estimated cost of $50 a year. The plant cost $4,000. The chemical analysis shows variations in results, but all nuisance is prevented.

There are several combinations of septic tank and other treatments in the State as follows:

Lake Shore & Michigan Southern railroad shops at Collinwood; two septic tanks and four contact beds, filled with two-inch limestone pieces; 500 employes; excellent results; cost, $6,800; maintenance, practically nothing.

Delaware, two septic tanks; three contact beds filled with coke and gravel; automatic distributer and discharging siphons; 8,000 population and 100,000 to 200,000 gallons daily sewage flow; cost, $12,900; has never been put into good working condition, owing to floods and lack of interest of city officials.

East Cleveland, receiving well and screen; centrifugal pump to septic tank; eight primary filters filled with coarse slag; aeration in flow to four secondary upward filters with similar filling; two filters filled with layers of coarse broken stone, pea coke, broken stone and sand, aerated by air forced into open space under bottom; 6,000 population, 400,000 to 1,400,000 gallons of sewage a day, owing to some storm water in sewers; good results; some odor from the stale sewage in the plant; cost, $66,292; maintenance cost, $2,980.

Mansfield, population, 20,000; population served 8,000 to 10,000, with average flow through works about 1,000,000 gallons a day; sewage pumped to four septic tanks, with capacity of twenty-four hours' flow; aeration on flow to five contact filters with five feet of cinders; results, good; cost, $70,623 for plant alone; maintenance, $4,000 a year.

Ohio Soldiers' and Sailors' Home, at Sandusky, population, 1,400; daily sewage flow, 100,000 to 125,000 gallons; two septic tanks; aeration; eight sand filters with automatic discharge upon them; good results, but complaint of odors when sewage was given twenty-four hours to pass through tanks; cost, $12,800; maintenance, one man, with occasional help from two or three more.

Trumbull County Infirmary at Warren, population, eighty to ninety; 2,000 to 3,000 gallons of sewage a day, increased in wet weather by leakage; septic tank discharging into reservoir; pump to two filter beds about once a day, filled with coarse coke with fine coke on top; good satisfaction except when flow of water is too great, but strong odor from tank and reservoir on account of long standing of sewage in them; cost, $1,167 plus much labor of inmates; maintenance, pump and man a half hour each day.

Westerville, population 1,500, with sewage flow including creamery waste of 20,000 to 25,000 gallons a day; two septic tanks; aerating flow to six contact beds, only three in use, filled with screened cinders; automatic distributer and discharging siphons; continuous cinder filter; good results; cost, $2,900; maintenance, one man two hours a month, which is not sufficient for uniformly good results.

WATER TIGHTNESS OF CONCRETE.*

By Frederick W. Taylor, M. E., and Sanford A. Thompson, Asso. Mem. Am. Soc. C. E.

A wall of concrete may be rendered water-tight in several ways:

(1) By accurately grading and proportioning the aggregates and the cement.

(2) By special treatment of the surface of the concrete.

(3) By the introduction of foreign ingredients into the mixture.

(4) By the application of layers of waterproof material, such as asphalt and felt.

It is often advisable to combine two or more of these methods.

The manner of laying the concrete in walls or floors which are to withstand water pressure is as important as the proportioning of its ingredients.

The chief points applicable to water-tight work are briefly recapitulated as follows:

(a) Mix concrete of quaking or of wet consistency.

(b) Place concrete carefully so as to leave no visible stone pockets.

(c) Lay the entire structure, if possible,

*Selected from a chapter in Taylor and Thompson's Treatise on Concrete Plain and Reinforced, published by John Wiley and Sons. Copyrighted 1905 by Frederick W. Taylor. All rights reserved.

in one continuous operation, working night and day when necessary.

(d) If joints are unavoidable, clean and roughen the old surface, then wet it and coat with a layer of cement or mortar.

(e) Make suitable provision for contraction by special joints, or by steel reinforcement without joints.

A series of experiments, conducted by the authors, upon several blocks of mortar mixed in the same proportions of cement, sand and stone, but with different proportions of water, indicates that the best consistency for concrete designed to withstand water pressure is intermediate between a quaking and a mushy mixture. Also, the general conclusion was reached that with the same dry materials the consistency producing the greatest density after setting gives the most impermeable mortar or concrete up to the point of a very wet consistency, when the excess of water affects the chemical composition of the cement, forming "laitance" and thus reduces both the strength and the water-tightness of the specimen. After setting, the very wet specimens were found to have about the same density as the medium and mushy mixtures, because the cement, sand, and stone settled into place and expelled the surplus water.

The proportions employed to resist the percolation of water usually range from 1:1:2 to 1:2½:4½, the most common mixtures being 1:2:4 or 1:2½:4½. However, with accurate grading by scientific methods, water-tight work may be obtained with proportions as lean as 1:3:7. Permeability, the quality of allowing water to pass through, and porosity, the property of containing pores or voids, are not synonymous terms, and the most porous material is not necessarily the most permeable, because the dimensions of the voids as well as their volume affect by capillarity the passage of water.

For maximum water-tightness a mortar or concrete may require a slightly larger proportion of fine grains in the sand than for maximum density or strength. A mixed aggregate has fewer channels through which the water can pass than aggregate consisting of coarse stone and sand, provided the character and relative proportioning of the finest particles are the same in both cases. To carry the comparison still further, a concrete should be less permeable, that is, more water-tight, than its mortar would be the stone were left out. According to Mr. William B. Fuller's experiments, the percentage of total voids in mortars averages about 26 per cent., while in concretes of proportions commonly employed in practice, the voids range from 13 to 17 per cent. In neither the concrete nor the mortar do these percentages ever represent air alone. A portion of the water, an amount estimated at 8 per cent of the weight of the cement, corresponding to about 2½ per cent of the volume of ordinary concrete, combines with the cement, and a still larger portion of the water remains in the pores unless dried by artificial heat.

Authorities disagree as to the relative advantages of small stone ranging between ½ and one inch, and coarse stone, ranging from ½ inch up to, say, 2½ inches. The latter is theoretically the better, but it is sometimes claimed that the fine material can be placed more satisfactorily. This depends upon the workmanship. With proper selection of materials and care in laying, the concrete containing the coarse stone produces excellent work, as is illustrated by the constructions at Little Falls, N. J., and Boonton, N. J., where carefully graded stone up to 2½ or 3-inch diameter was used.

If very fine stone, under ½-inch, and containing dust, is used for the coarser aggregate, the addition of sand may increase the porosity and the permeability, because concrete with such small stone is practically a mortar, and the finer particles of stone are really sand. A concrete in proportions 1 part cement; 2 parts sand; 4 parts unscreened stone less than ½-inch diameter, makes a porous concrete, while a mixture 1 part cement; 2 parts sand; 4 parts stone ¼-inch to 1½-inch diameter, makes a dense one. With the small stone, proportions 1:1:2 would be the leanest advisable mixture.

Thickness of Concrete for Water-tight Work.—It is impossible to specify definite thicknesses of concrete to prevent percolation under different heads of water, because of variations in proportions and methods of laying. We have known rain water under a head of 2 or 3 inches to percolate through a 4-foot wall of excellent concrete. On the other hand, had the same materials been mixed to a wetter consistency and placed with no joints between successive layers, concrete but a few inches thick would have withstood a high head. The best criterions for thicknesses of walls of first-class concrete are obtained from actual examples. Instances are cited of water-tight concrete 4 inches thick sustaining a head of 4 feet; concrete 15 inches thick sustaining

a head of 40 feet; and concrete 5.5 feet thick sustaining a head of 100 feet.

Special Treatment of Surface.—Various methods of treating the surface of concrete have been employed to increase the water-tightness.

Plastering.—Plastering the surface of concrete with rich Portland cement mortar in proportions 1:1 to 1:1½ is the method which first occurs to one, but in temperate or cold climates it is only useful for walls below the surface of the ground and therefore not subject to atmospheric changes. In such cases it can sometimes be used as a substitute for, or in connection with, paper and asphalt. In certain sections of the Boston Subway, a 6-inch wall of concrete was laid up next to the bank and plastered with a layer of 1:1 mortar about ½ inch thick. After spreading the mortar with a plasterer's ordinary metal float the surface was run over with a toothed roller about 22 inches long by 4 inches in diameter, which pressed the plaster into any crevices, and left a rough surface. The main wall of concrete forming the lining of the Subway was then laid up against this plastered surface. On the arch of the approaches to the East Boston tunnel, a layer of plaster, like that on the walls, was spread before laying the final 6-inch thickness of concrete, thus forming a water-tight joint in the interior of the arch ring.

Granolithic Finish.—On horizontal or inclined surfaces, a granolithic surface of rich mortar of Portland cement and sand, or Portland cement and screenings in proportions about 1:1 may be laid and troweled, as in sidewalk construction The surface finish must be placed at the same time as the base, and with the same, that is, Portland, cement.

Troweling Surface.—The water-tightness of horizontal or inclined layers of concrete can be greatly increased by troweling the concrete in the same manner that granolithic work is troweled. This brings the cement to the surface, and produces a dense, hard surface which is nearly equal to a surfacing of rich mortar. This is very effective for surfacing a structure like the inclined face of a dam. In experimenting upon the permeability of different concretes, the authors have noticed that even the very light jogging which is necessary to compact a wet concrete, and also the ramming of a stiffer mixture, increases the impermeability of the concrete. Even after chipping off the top of the specimen for depth of one-eighth or one-fourth of an inch, the flow will be several times less than when the pressure is directed upon its under surface.

Grout—Portland cement grout is preferable to plaster for coating the soffits of arches or for wall surfaces. It is also valuable for coating the interior of cisterns or tanks. The grout should of course be applied against the surface which is to come in contact with the water, and if the wall is to be made impervious in both directions, both sides should be washed.

A specially prepared cement wash has been found effective in preventing dampness in masonry.

Introduction of Foreign Ingredients—The principal advantage of introducing foreign ingredients into a mortar or concrete is to permit the use of a lean mixture, the fine particles of hydrated lime, or whatever may be used, tending to reduce the volume and the dimensions of the voids.

Lime and Puzzolan Cement—The effect of the addition of lime in small quantities is chiefly mechanical, and the quantity which should be employed depends, therefore, upon the fineness of the sand and the proportions of the mixture. It appears impossible to replace the water which separates the grains of cement or cement and sand in peat paste or 1:1 or 1:2 mortar with a material like lime. It can only be used to advantage, therefore, with mortars leaner than 1:2. In the authors' tests 1:2½:5 concrtte was made more water-tight, although its strength was slightly reduced, by substituting an equal weight of lime paste for 10 per cent by weight of the cement. Unslaked lime must not be used under any circumstances.

Puzzolan cement, unlike lime, tends to increase the strength even of neat cement and rich mortars, in many cases 20 per cent by weight of total dry materials being beneficial if the puzzolan cement is ground with the Portland. Undoubtedly the impermeability is similarly increased, since mixtures of Portland and puzzolan cements have been found to well resist the action of sea water.

Pulverized Rock—Mortars 1:3 and leaner, and concrete made with these proportions of cement and sand to the stone, are increased in strength, and probably in impermeability, by the addition of rock pulverized as finely as the cement and equal to it in weight, although if the

natural sand is very fine or contains dust, the addition of fine material is not beneficial.

Alum and Soap—A soap and alum mixture in various proportions sometimes is used to make what is called "waterproof mortar." The Sylvester Process mixture employed in New York Harbor by Maj. W. L. Marshall was made by "taking one part cement and 2½ parts sand and adding thereto three-fourths of a pound of pulverized alum (dry) to each cubic foot of sand, all of which was first mixed dry, then the proper amount of water—in which had been dissolved about three-fourth of a pound of soap to the gallon of water—was added, and the mixing thoroughly completed. The mixture is little inferior in strength to ordinary mortar of the same proportions and is impervious to water, and is also useful in preventing efflorescence." The effect of alum and soap in diminishing the permeability has been experimented upon by Mr. Edward Cunningham and Prof. W. K. Hatt, and found useful for small structures.

Layers of Waterproof Material—Layers of waterproof paper or felt cemented together with asphalt or bitumen or tar are extensively used—and sometimes asphalt alone—to form an impervious layer. A mixture of alum and lye has also been tried.

Paper or Felt Waterproofing—Layers of paper or felt with tar or asphalt between them are employed for a waterproof course in concrete floors, roofs and walls of underground structures of large or long area, like tunnels and subways, which require special protection from infiltration of water. The materials range from ordinary tarred paper, laid with coal tar pitch, to asbestos or asphalted felt, laid in asphalt. Coal tar products will deteriorate when continually exposed to moisture, and are therefore not adapted for important locations. ((Coal tar itself does not so deteriorate.—Editor.)

In the New York subway, portions of which are built below tide-water, much of the waterproofing consists of layers of felt laid in asphalt.

Method of Laying Paper or Felt—The waterproof layer of a floor may be laid directly upon the ground if the soil is fairly dry and firm, but is usually spread upon a layer of concrete from four to eight inches thick. In the former case the first layer consists of strips with a two to six-inch lap cemented with asphalt, and the remaining layers are mopped on. Upon a concrete base it is customary to first spread a layer of asphalt upon the concrete, although, if the concrete is damp, the bottom layer of paper or felt may be placed dry, as described above.

The "ply" in waterproofing—that is, the number of layers which cover all parts of the surface—varies from two-ply to ten-ply. It is considered better practice to "shingle" the strips than to place each ply or layer independently. If the surface to be waterproofed is rough it may be leveled with cement mortar. It must be dry before applying the tar or asphalt. The asphalt is heated and brought, generally in buckets, to the work. Several rolls of paper are started consecutively. Ahead of each roll, as it is unrolled, the liquid asphalt is swabbed upon the concrete with a mop, so that the paper or felt is spread directly upon the fresh hot stuff. As soon as the first roll is started the second is placed to overlap the first, a width depending upon the number of ply to be laid. For example, if the felt is thirty-two inches wide and is laid three-ply, the second roll is lapped upon the first about twenty-two inches. As this is unrolled (in the same general direction as the first roll) the surface ahead of it is mopped with asphalt, as described above. A third roll is immediately started, lapping both of the two others, and so on for the entire width of the surface to be covered.

A waterproof course of this character always forms a distinct joint in the mass, thus destroying its cohesion upon that plane, and the strength of the concrete in bending on the two sides of the layer must be considered independently.

Asphalt Waterproofing.—Asphalt is sometimes laid as a waterproof course in one or more continuous sheets, and is also used for filling contraction joints in concrete.

In the sedimentation basin for the Albany (N. Y.) Filtration Plant sixteen inches of clay and gravel puddle were covered with six inches of concrete laid in blocks seven feet square, with one-half-inch asphalt joints three inches deep, that is, extending half-way through the concrete. This proved to be a successful treatment.

In the Astoria (Ore.) water works the bottom of the reservoir consisted of six inches of concrete in approximate proportions, one packed cement, 0.7 sand, 3.5 fine gravel, 6.5 broken stone, covered

with a three-eighths-inch finishing coat of 1:1 mortar and upon this two layers of Alcatraz brand asphalt. The first layer was of natural liquid asphalt, and the second was the product of refining natural rock asphalt with about 20 per cent of the liquid as a flux. Mr. Adams made the rule that no asphalt should be placed until after the concrete had set at least two weeks, and was well dried out. All dust was carefully removed from the concrete, and the asphalt was applied with twine mops. The slopes of the reservoir were lined with brick laid in asphalt upon six inches of concrete. Under ordinary conditions such complete measures are unnecessary.

In the construction of government fortifications by the United States Army Engineers, numerous methods of waterproofing have been used, in some cases an asphalt course being placed between two layers of concrete. Asphalt paint has been used for a protective coating where earth is to be deposited above or against it.

A one-fourth-inch coating of asphalt applied hot with a mop upon a surface already covered with grout has been satisfactorily used by Mr. J. W. Schaub for coating the interior of tanks where the head is greater than ten feet. He considers this sufficient to withstand a water pressure of sixty feet. Mr. Schaub also suggests the method of building the wall in two parts and filling the core or hollow space between with asphalt.

Alum and Lye Waterproof Wash—The United States Army Engineers have sometimes satisfactorily employed for a waterproof wash a mixture of concentrated lye and alum in proportions one pound lye to five pounds alum with proper precautions in mixing and placing it.

Results of Experiments on Permeability—Mr. R. Fere in an extended series of experiments upon cement mortars reached the conclusions (a) that with mortars of the same granulometric composition the most impermeable were those which contained the largest percentage of cement, (b) of mortars containing the same percentage of cement, but of variable granulometric composition, the most impermeable were those containing equal parts of coarse and fine grains, the latter including the cement, (c) decomposition by the passage of sea water through mortars mixed in equal proportions by weight increases as the sand contains more fine grains.

Mr. Paul Alexandre found that mixed sands made a much more impermeable mortar than fine or coarse alone. Mr. Thomas F. Richardson reached similar conclusions, and contrary to the French experiments, his results indicate in general that mixtures giving maximum strength also give maximum impermeability.

The consistency in mixing the concrete affects the permeability only indirectly. Experiments by the authors indicate in general that the mixture giving the greatest density is apt to be most water-tight.

Methods of Testing Permeability—The relative permeability of different specimens of concrete may be tested by a method similar to that employed by the French Commission for mortar, although the area of surface in contact with the material (the area of the tube) is so small that impurities in the water are liable to fill the pores and affect the results of time tests. For rough comparative tests the authors have satisfactorily employed discs about nine inches in diameter and eight inches thick, to the surface of which a one-inch iron pipe is cemented. An ordinary pipe flange is screwed on to the pipe, so that the end of the pipe projects through it about one-fourth inch. A one-fourth-inch layer of neat cement in a stiff paste is plastered upon the under side of the flange (using care not to close the end of the pipe) and the pipe is set upon the specimen and a cone of neat cement formed upon the top of the flange and around it and the pipe so as to cover the entire surface of the specimen. After setting for a few days the specimen can be quite roughly handled without breaking the joint between the neat cement and the concrete or the cement and the pipe.

The method of immersing the specimen in water advocated by the French Commission was found unsatisfactory for tests of short duration. The specimen was therefore soaked in water for twenty-four hours, removed from the water just before the test was commenced and allowed to drain one minute, when the pipe was connected with the pressure, about eighty pounds. The specimen was suspended over a receptacle, and the water passing through it was weighed at intervals. In some cases an idea of the amount of water passing was quickly

obtained by counting the drops per minute or noting by a stop-watch the time between the drops.

By molding the specimen of concrete or mortar in an iron pipe or in a casing of neat cement, and connecting the end with the water pressure, a large surface of water contact may be given to the specimen, and the thickness of the material through which the water passes may be more definitely defined. A difficulty encountered when employing an iron pipe is the shrinkage of the cement on setting which is liable to separate the specimen from the tube. On long time tests, loss by evaporation must be prevented.

NATURAL HYDRAULIC CEMENT.

Grinding the Clinker.

By Edwin C. Eckel, U. S. Geological Survey, Washington, D. C.

When natural cement was first manufactured in this country, the millstones used at flour mills were the only available fine grinders. Grinding practice at natural cement plants was therefore soon established in a form which has persisted, at many plants, until the present day. Even now a few small plants, I believe, grind natural cement and flour in the same building and at different times of the year.

Until quite recently, grinding practice was almost uniform. The burned rock was sledged if necessary, fed through a cracker or other comparatively coarse reducer, and finished on millstones of one type or another. Within the past few years modern grinding machinery has been introduced at a few plants, and has given such satisfactory results that no natural cement manufacturer can afford to disregard the innovations.

Hard and Soft Clinker.—When a natural cement kiln is drawn, part of the product will consist of hard, clinkered material, part of softer, porous, moderately burned stuff, and part of cores and masses of practically unburned rock. The relative proportions in which these three grades are present will be determined by the type of kiln and the care with which the burning has been conducted. The differences in burning are of course due, to some extent, to the fact that the masses of rock fed into the kiln differed among themselves in composition, but they are mostly due to the different extent to which the masses have been exposed to the heat of the fuel.

The facts above stated are obvious enough, and the matter might be passed over without further notice, if it were not the case that with some rocks the clinkered product will give the least cement, while with other rocks the medium burned part of the product is the best. The fact certainly requires both consideration and explanation.

The facts themselves are beyond question. In the Rosendale district, for example, from ten to twenty per cent of the output of the kiln is clinkered material. The clinker is thrown away, for experiments have shown that it gives a cement not nearly as good as the moderately burned product. In the Akron-Buffalo district, on the other hand, the hard, clinkered parts of the product are carefully separated and ground, for experience has shown that its product is much stronger than the softer, more porous masses. These separate facts have been noted by many writers, but no explanation has been offered.

The following seems to explain the difference in practice satisfactorily. It has been noted in a previous article that the lower limed the cement, the higher the temperature necessary to secure perfect combination of the lime and clay. The Rosendale rock, relatively high in clayey matter, will therefore be properly burned at a much lower temperature than the Akron rock, which is relatively low in clay. But a low temperature means low fuel costs, and so there is not the temptation to economize on fuel, in burning a low limed rock that there is of burning one low in clay. When high-clay rocks are burned, therefore, the temperature and the fuel supply will often be allowed to exceed their proper amount, resulting in the production of clinkered material, which has been burned higher than was necessary, and is therefore inferior. But in burning a rock of low index, it will be necessary to almost clinker the material before perfect combination is secured.

Because of the natural tendency to economize on fuel, the temperature will usually be carried a little lower than is necessary. The result is that in burning rocks of low index, the clinkered material is correctly burned, and gives the best cement, while the softer masses are really underburned and therefore inferior.

The respective values of the hard and soft parts of the product will therefore depend on the composition of the cementation index.

Seasoning and Slaking—It is obvious that in burning a natural rock in a kiln whose temperature can not be controlled closely, there are opportunities for great differences between the degree of burning which the rock should have received, and the degree which it actually received. When the percentage of clayey matter in the product is very high, even a light burning will suffice to decarbonate all of the limestone and to secure combination of the lime with the clayey matter. This is especially true if the silica is comparatively low, and the aluminum and iron oxide high. A rock of this general type can therefore vary quite widely in composition and degree of burning without running any risk of turning out an unsound product.

As the percentages of lime and magnesia rise, however, the problem becomes more difficult, and when the clay falls very low a comparatively slight variation in the composition of the rock or in the degree to which it is burned is apt to give a product containing too much free lime for safety.

When this condition—the presence of free lime or magnesia in the product—occurs frequently, the manufacturer has three options. He may (1) burn at a higher temperature, (2) look for a lower limed rock, or (3) slake the free lime in some way. The first choice would usually be the best, but in nine cases out of ten the manufacturer will take the third, as being the cheapest.

Free lime in a natural cement may be neutralized either by aerating the ground cement, or by sprinkling or steaming the unground clinker. When aeration is practiced, the ground cement must be exposed to the air as freely as possible. This implies that it should be spread out, rather than placed in deep bins; and consequently requires considerable floor-space and manual labor. Steaming or sprinkling the unground clinker requires less space and labor, but care must be taken that excess of steam or water is not allowed to reach the cement. The ideal aimed at is to supply sufficient moisture to slake the free lime, but to leave the aluminates and silicates untouched. Simple storage of the clinker with free access to the air, will often accomplish this result. An incidental benefit to the manufacturer which comes from slaking the clinker (either by steaming, sprinkling or storage) lies in the fact that the lime, in slaking, helps to disintegrate the clinker and thus reduce the cost of grinding.

Actual Mill Equipments—The variations in practice which now exist can best be understood by reference to the following data on the actual equipments of a number of the best American mills:

Mill 1—1,500 bbls. per day—
- a. 1 Gates crusher.
- b. 2 Lindhard kommuters.
- c. 2 Davidsen tubemills.

Mill 2—1,600 bbls. per day—
- a. 5 McEntee crackers.
- b. 16 run Esopus millstones.

Mill 3—200 bbls per day (run only about one-third time)—
- a. 1 coarse pot crusher.
- b. 1 fine pot crusher.
- c. 1 Williams mill.

Mill 4—100 bbls. per day—
- a. 1 Williams mill.
- b. 1 16-ft. Bonnot tubemill.

Mill 5—
- a. Sturtevant crushers.
- b. Cummings grinders.
- c. 10 run millstones, iron plates.
- d. 10 run Esopus millstones.

Mill 6—
- a. Pot crushers.
- b. Esopus millstones.

Mill 7—800 bbls. per day—
- a. 1 Gates crusher.
- b. 2 dry pans.
- c. 1 Davidsen tubemill.

Mill 8—500 bbls. per day—
- a. 1 pot crusher.
- b. 1 Williams mill.

Mill 9—
- a. Stedman disintegrators.
- b. Griffin mills.

Types of Grinding Machinery Employed—In a volume now in press, where the crushing and grinding machinery used in Portland cement is described in detail, a classification of these machines is introduced as a guide to the descriptions of individual machines. As all but one of the groups there distinguished are represented by one or more machines used in natural cement mills, the same grouping will be used in the present article. It is as follows:

Class 1. Jaw crushers; material crushed between two jaws which approach and recede. Blake crusher.

Class 2. Cone grinders; material crush-

ed by a revolution of a toothed cone or spindle within a toothed cup. Gates crusher, crackers.

Class 3. Rolls; material crushed between two or more plain, fluted, or toothed cylinders revolving in opposite directions.

Class 4. Millstones; material crushed between two flat or grooved discs, one of which revolves. Millstones, buhrs, Sturtevant emery mill, Cummings mill.

Class 5. Edge runners; material crushed in a pan under a cylinder turning on a horizontal axis and gyrating about a vertical axis. Edge runners, dry pans.

Class 6. Centrifugal Grinders; material crushed between rollers and an annular die, against which the rollers are pressed by centrifugal force. Huntington mill, Griffin mill, Narod mill, Clark pulverizer.

Class 7. Ball Grinders; material crushed by balls or pebbles rolling freely in a revolving horizontal cylinder. Kominuter, ball mill, tubemill.

Class 8. Impact Pulverizers; material crushed by a blow in space delivered by revolving hammers, bars, cups, or cages. Williams mill, Raymond pulverizers, Sturtevant disintegrator, Cyclone pulverizer.

Jaw Crushers.—So far as known to the writer, no jaw crushers of the Blake type are at present used in natural cement plants. At one plant, and possibly at others, the Sturtevant roll-jaw crusher is in use as a preliminary reducer on clinker.

Cone Grinders.—Though the heavier crushers of this class are used at but few natural cement plants, the group includes a series of machines which have always been held in favor as preliminary reducers on natural cement clinker—the so-called "crackers," so extensively used in the natural cement industry, of which the McEntee cracker of the Rosendale district may be taken as typical. They differ but little in design, and consist of two concentric cone-shaped castings, both provided on their adjacent surfaces with a series of grooves and flanges. Gillmore states* that the elements of the lower portions of both cones makes a smaller angle with the common axis than the elements of the upper portions, with a view to lessen the strain and the effects of a sudden shock on the machinery by securing a more gradual reduction of the stone to the required size. These lower portions being subject to very rapid wearing, are made of chilled iron, and are moreover cast in separate pieces, in order that they may be replaced by new ones as occasion requires. The greatest diameter of the core at the top, including the flanges, is 9 inches, at the bottom 5½ to 6 inches, and its height is 15 or 16 inches. The diameter of the shell, measured within the largest flanges, is 14 to 15 inches at the top, and a trifle greater than that of the core at the bottom, while its height is 16½ to 18 inches. One cracker of this size, working with a velocity of 80 to 85 revolutions per minute, is sufficient for a mill grinding 250 to 300 barrels per day. It is customary to provide one cracker for every two run of millstones." In the data given above, it will be noted that each of the heavier McEntee crackers now in use is expected to supply three runs of millstones at one of the modern Rosedale mills.

Rolls.—Rolls are not used in any American natural cement plant.

Millstones.—This group includes a series of mills very important in natural cement practice. The ordinary millstones and buhrstones have been used in this industry since its commencement in 1818, while the Sturtevant "rock-emery" mill and the Cummings grinder represent modern types.

In the Sturtevant rock-emery mill the ordinary millstones or buhrstones are replaced by a "rock-emery" stone. This is composed of a circular iron cup or shell. The center of the circle is made up of a disc of buhrstone, while the portion nearer the rim is set with slabs of "rock-emery" cemented by metal poured in while molten. Radical strips of buhrstone are set so as to continue the furrows of the central buhrstone to the rim of the wheel. The idea is to prevent unequal wear, for in an ordinary millstone the rim wears much faster than the central area. These rock-emery millstones are listed by the manufacturers at the following prices per pair, f. o. b., Boston: 30-inch, $100; 36-inch, $150; 42-inch, $200; 48-inch, $250; 54-inch, $300.

The Sturtevant rock-emery mill itself, which uses the stones above described, is made both as a vertical and horizontal mill, the latter being preferable for harder work. The horizontal mill is made only in the 42-inch size, with underrunner stone. The running stone, the under one in this mill, is rigidly fixed to the head of the large vertical shaft, which is made

*Limes, Hydraulic Cements and Mortars, p. 160.

to revolve by a pulley placed on it below the millstones.

The Cummings Grinder* crushes material between two vertical chilled-iron discs, one of which is stationary, while the other is revolved at high speed. The faces of both discs are cut into a series of bands and furrows, and the material fed between them is disintegrated rapidly. It is stated that this mill, when working on hard natural cement clinker, has given very satisfactory results. "The clinker is fed to the mill broken to about the size of one-inch cubes, and is reduced to about the size of wheat and from that down to dust, at the rate of twenty tons per hour. This work requires fifty horse power. In a trial, this mill has reduced hydraulic cement (taken direct from the kilns, with the softer portions mixed with the clinker, the latter amounting to about one-third of the total) at the rate of 1,300 pounds per minute, the product passing 50 mesh wire screens. The cost of renewal of the grinding plates has been $10 per month, no other repairs being necessary.

Using the data above quoted as basis for calculation, it may be seen that the Cummings grinder, when used as a coarse reducer, taking material of one-inch size and reducing it to say one-sixteenth inch, requires 2.7 horse power per barrel (300 pounds) cement. When used as a complete grinder, taking coarse clinker and reducing it all to pass 50 mesh, it requires 5.2 horse power per barrel of cement.

Though no direct statement is made by Mr. Ball, it is perhaps fair to assume that the trial noted above took place at the mill of the Cummings Cement Co., in Akron, N. Y. It must be recollected that the cement rock of Western New York is of very low index, and that the hard clinkered portions are therefore very valuable when ground.

Edge Runners.—Dry pans are in use at only one natural cement plant, where they take a moderately soft clinker from the crusher and prepare it for the tube mill. Two drypans are in use, taking about 15 horse power each, and handling about 400 barrels each for a day of ten hours, equivalent to a power requirement of about 0.4 horse power per barrel of cement.

Centrifugal Grinders—Two machines of this type—the Griffin mill and the Clark pulverizer—are in limited use in the natural cement industry.

The Clark anti-friction pulverizer has been supplied to two of the plants of the Louisville district, for use as an intermediate reducer.

The Griffin mill is, to the writer's knowledge, little used in the natural cement industry. The only instances of its use that have come to his acquaintance are in grinding the hard portions of the clinker produced at a natural cement plant in Western New York, and as an intermediate reducer in one of the mills of the Louisville district.

Ball Grinders.—This group includes three very important and efficient machines—the kominuter, the ball-mill and the tubemill. All three of these are now in operation in one important natural cement district, and all have proven satisfactory, though in different degrees.

In handling natural cement clinker, certain things seem to have been firmly established by the experience of the district above alluded to. These facts may be summarized as follows: The tubemill, applied to the reduction of natural cement, is an unqualified success. When working on this material its output is very large, while its repairs and wear of pebbles are trifling. The kominuter, efficient enough in actual grinding, seems to give some trouble in regard to repairs of certain parts. As the kominuter is a very recent invention, it is probable that these defects will soon be remedied. The ball mill is much worse than the kominuter as regards repairs.

Two Lindhard kominuters were run for 13½ months on a rather hard-burned natural cement clinker, during which time they turned out "considerably over" 400,000 barrels of cement. The repair expenses for the same period amounted to $300.18, which include the cost ($182.70) of one extra set of screen frames.

Two Davidsen tubemills, running on natural cement clinker for 26 months, turned out 694,522 barrels of cement. During this time nothing was expended for repairs. The mills were only dumped once, and the total loss of screening pebbles amounted to less than one barrel. The linings, silex and iron, and the bearings were all found in good condition, with little or no wear to speak of. Another pair of tubemills made a similar record in regard to output and repairs.

*Ball, C. M. The Cummings Ore Granulating Mill. Trans. Amer. Institute Mining Engrs., vol. xxi, pp. 516-619. 1903.

Impact Pulverizers.—The Stedman disintegrator is used in at least one natural cement plant as a preliminary reducer on hard, partly clinkered material.

The Williams mill is a high-speed pulverizer in which revolving hammers accomplish the reduction. It is in use in at least three natural cement plants, to the writer's knowledge. In two of them, at Fort Scott, Kansas, it is employed as a final reducer, taking a medium soft clinker from pot crushers and reducing it to all pass 50 mesh. In this work it is furnishing 50 to 75 barrels (265 lbs.) of cement per hour. At the Pembina plant in North Dakota, the Williams mill is used as a preliminary reducer, to prepare the material for the tube mill. In this work, which is on very hard clinker, it is handling about 20 barrels per hour.

CEMENT FILLER FOR BRICK PAVEMENTS.

By E. A. Kemmier, Assistant Engineer, Department of Public Service, Columbus, O.

In your March number there appears an article by Prof. I. O. Baker on "Joint Fillers for Brick Pavements," the concluding statement of which is so contrary to experience that it should not be permitted to go unchallenged. To one who has seen the effects of cement filled brick streets on crushed stone or gravel foundations, the following extract from the article must seem remarkable:

"It is better economy to use a good Portland cement filler and omit the cement from the foundation, i. e., use a macadam foundation instead of a concrete one, than to use a sand filler and a concrete foundation."

Experience is the best guide in settling this question, and if the experience in Illinois shows that cement filler streets on newly made macadam foundation do not fail by cracking, settling in rectangular patches, or developing that characteristic "hollow sound," then there is something in the Illinois soil and the preparation of the foundation which is different than anywhere else, and it would be interesting to know just how such results are obtained.

I have seen such pavements fail even on concrete foundation, by straight, rectangular breaks and settlements. More than that, we have a Medina sandstone block pavement on concrete foundation, with a minimum thickness of sand cushion. Every precaution was taken to make this as near perfect as possible, notwithstanding which several weak spots developed, and the pavement went down in small square patches, one of them not more than fifteen inches in size.

While it is true that the cement filler gives the pavement additional strength, this should not be taken into consideration in the construction of the street. It must be borne in mind that the pavement cannot adjust itself to any little changes that develop in the foundation and sand-cushion of every street, like a tar-filled pavement; consequently the pavement retains its position, while the foundation and cushion separate from it, and when the span has reached a certain length, the section of pavement affected must fail, by breaking in rectangular areas and settling. I have seen such settlements as much as two inches in amount, on badly constructed streets.

The conclusion of the matter is, that for a stiff, rigid superstructure, we must have a firm, rigid substructure, prepared to conform as nearly to a crown parallel to the finished crown of the street as it can be made, smooth and true, and a minimum thickness of sand-cushion. Longitudinal expansion joints at the curblines and transverse joints at certain intervals, to prevent expansion—cracks and upheavals, are likewise essential.

Had Prof. Baker given the advice quoted from his article to the city of Columbus about twelve years ago they could not have followed his plan closer than they did. And had he gazed upon those ten or more streets constructed in this manner, two or three years later, he would have experienced one of the disappointments of his life. All of the phenomena characteristic of cement-filled streets constructed upon wrong principles, developed; patch after patch broke and settled; longitudinal cracks, sometimes 100 to 150 feet long, appeared; rumbling noise was apparent everywhere, until all hollow places had been closed up by the settlements. The depressed portions wore out much faster than the remainder, hence these streets soon as-

sumed an unsightly, yes, ugly, appearance.

Having been in charge of the construction of our streets some six years, 1897 to 1903, I have had the opportunity of studying these pavements and the causes which led to their destruction, as well as those constructed in the last eight years on concrete foundation. I find that every street on macadam foundation was a failure, and every street on concrete a success. There have been a few isolated cases of small depression, but of no consequence.

The conclusion which I have drawn from my observations, here and elsewhere, is, if you have not money enough for Portland cement in both filler and foundation, use it in the foundation; it will at least be safer, and you take no chances. But, considering the trifling additional cost of the cement filler, it should be used in both places.

Prof. Baker enumerates the advantages of the cement-filler, all of which I subscribe to; but the subject is not complete without stating the disadvantages. On account of the increased smoothness it affords a poorer foot-hold for horses than the other filler. It requires a better class of workmanship to prevent failure. It is difficult to repair and almost impossible to break the joint in repairing, especially along a longitudinal cut for a sewer-pipe or conduit. The cement filler cannot be used to advantage in repairing, because the street cannot be closed for traffic long enough to allow the cement to harden. Yet withal it makes the best, most economic and most satisfactory street that is known today.

REGULATION OF GAS AND ELECTRIC RATES IN SAN FRANCISCO.

By Alton D. Adams, Worcester, Mass.

San Francisco presents the unusual case of a great city where the rates for gas and electric supply are fixed by law. Power to fix the rates for public service of gas and electric plants rests with the State Legislatures, subject to the limitation imposed by the federal and most State constitutions that the rates so fixed must allow a fair return on the value of the property devoted to the service. Cities and towns have no power to fix gas or electric rates unless it is delegated to them by the Legislature of the State in which they are located, but this power is given to the Board of Supervisors by the charter of the city and county of San Francisco that went into effect Jan. 8, 1900. Under this charter the board has power to fix by ordinance the rates for water, heat, light or power supplied to the city or county, or their inhabitants in February of each year.

For the years ending June 30, 1904, and June 30, 1905, respectively, the maximum rate fixed by the board for electric energy used in incandescent lighting was 11 cents per 1,000 watt hours. Discounts from this maximum rate are provided that reduce it to the following figures, according to the amounts of energy consumed per month per connected lamp of sixteen nominal candle power in use by each consumer:

Watt hours per lamp per month.	Net rate per kw. hour cents.
2,000 to 3,000	10.45
3,000 to 4,000	9.90
4,000 to 5,000	9.35
5,000 to 6,000	8.80
6,000 to 7,000	8.25
7,000 to 8,000	7.70
8,000 to 9,000	7.15
Over 9,000	6.60

For multiple arc lamps on a meter basis the rates just named apply with the proviso that each one-half ampere of current used in an arc lamp is taken to be equivalent to one incandescent lamp for the purpose of fixing the rate. Thus an arc lamp on constant pressure mains that takes five amperes must consume 50,000 to 60,000 watt hours per month in order to get the rates of 8.8 cents per kilowatt hour. A charge of $1.50 per month may be made for the use of a meter where the charge for energy does not reach that sum, and this meter rent then covers the price of the energy actually consumed.

For the year ending June 30, 1905, the maximum charges for series arc lamps operating with 7.5 amperes and not less than seventy volts each are as follows:

Each lamp operating twenty-four hours during every day, $5.50 per week.

Each lamp operating from sunrise to sunset every day, $3.30 per week.

Each lamp operating from sunset to sunrise, $2.50 per week.

Each lamp operating from sunset to midnight every day, $1.75 per week.

Each lamp operating from sunset to 9:30 p. m. six days, $1.65 per week.

During the year ending June 30, 1904, the rates fixed for nominal 2,000 candle power arc lamps were a little higher than those last named. For electric energy used in motors the same rates were fixed for the years ending on June 30 in 1904 and 1905, the maximum rate being 10 cents per kilowatt hour in cases where the energy consumed per month amounts to less than twenty-five kilowatts per horse power of motor capacity. For larger amounts of electric motive power the rates are as follows:

Kw. hours per motor H. P. per month.	Net rate per kw. hour cents.
25 to 37.5	9.5
37.5 to 50	9.0
50 to 62.5	8.5
62.5 to 75	8.0
75 to 87.5	7.5
87.5 to 100	7.0
100 to 112.5	6.5
Above 112.5	6.0

Comparing the above rates fixed by law with those usually made by electric companies in large cities, the maximum figure of 11 cents per kilowatt hour for incandescent lighting is rather low. On the other hand, the net rates to large consumers of energy for both light and power purposes are decidedly higher than those charged in many cities. In other words, these rates fixed by the board are more nearly uniform as between large and small consumers than those found in usual practice. The maximum rate of 10 cents per kilowatt hour for energy used in motors is not an uncommon one, but here again the net rates to large consumers are decidedly higher than in many other places. It is to be noted, however, that all of the rates fixed are merely maximum rates for the conditions named, and there seems to be nothing to prevent the giving of lower rates in cases where the electric companies so elect.

For gas of nineteen candle power at the open burner, the rate fixed by board in 1903, and still in force, is $1.20 per 1,000 cubic feet, whether the gas is sold to private consumers or to the city. This same rate applies to gas sold for heating. For gas street lamps the rate is 8.7 cents per lamp per night including all care, these lamps to burn from thirty minutes after sunset to thirty minutes before sunrise. These gas rates seem high compared with those for electric energy, and also in comparison with the actual prices at which gas was sold in 1902. In the gas investigation at San Francisco in that year it appeared that the Equitable Gas Light Company made and distributed its gas at a total cost of 43.78 cents per 1,000 cubic feet, and that the average price received for this gas was 51.47 cents per 1,000 feet. Of that total cost of 43.78 cents per 1,000 feet of gas distributed by the company just named, 32.67 cents covered the cost in holder, and 11.11 cents was the cost of distribution. The San Francisco Gas and Electric Company made gas at a cost of 36.62 cents in the holder, but gave the extraordinary figure of 41.79 cents as the cost of distribution, thus raising the total cost to 78.41 cents per 1,000 feet. The average selling price of gas by this company was 92 cents per 1,000. Gas made by the Independent Gas Light Company cost 35.39 cents in the holder, and was sold for 75 cents per 1,000.

ARCHITECTURAL CONCRETE WORK IN EUROPEAN CITIES.

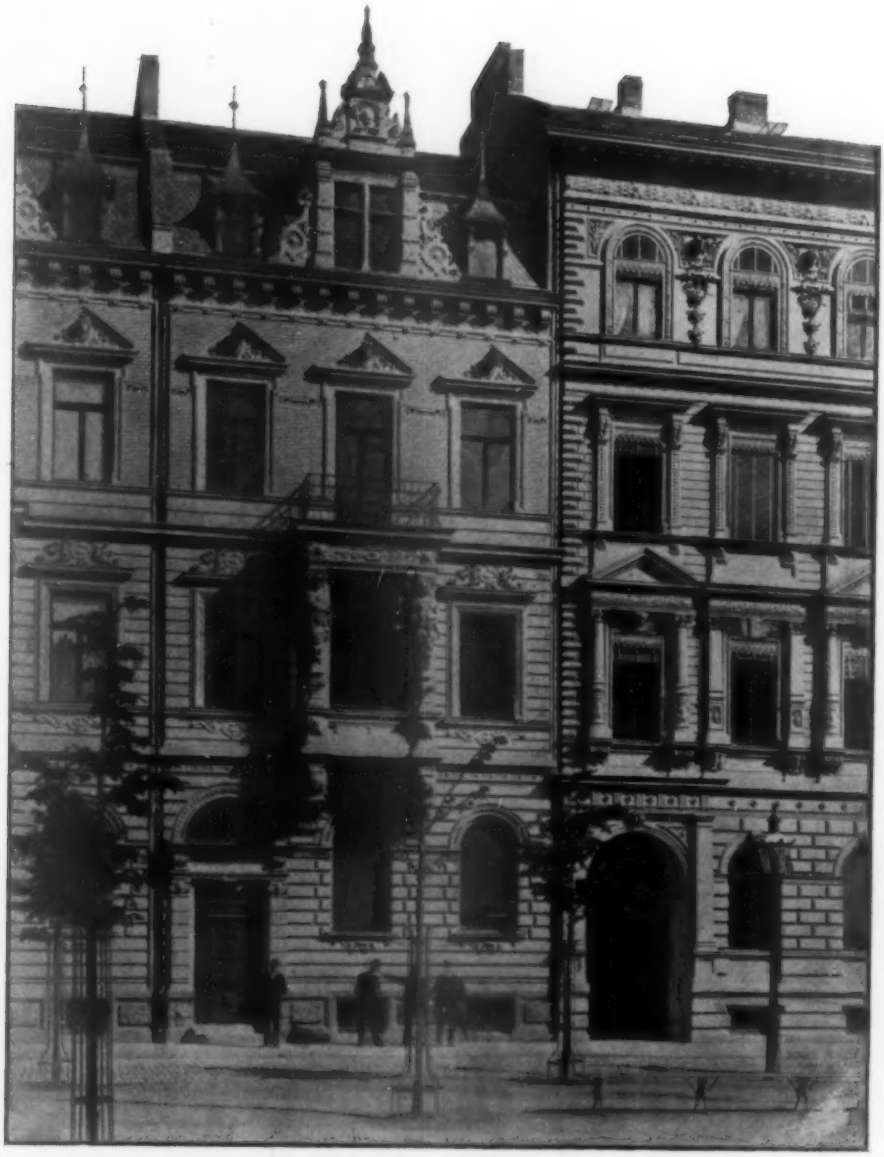
By Paul Wilkes, Cleveland, O.

Artificial stone has been used in the northern part of Europe for ornamental building for the last twenty-five years. During that time concrete had a hard struggle against natural stone over which it gained a partial victory.

Without doubt most art-stone for ornamental building is used in Western Germany, then in France, in the vicinity of Paris, and it is also used in Holland, Belgium and to some extent in England. In the larger Rhine cities of Germany you frequently find outside of the cities entire streets where the buildings have been erected with art stone.

The architects in those countries no longer doubt the utility, durability and beauty of cement stones provided they are properly made.

For the layman it is sometimes impossi-



ARTIFICIAL STONE WORK BY J. WILKES AND SONS, GERMANY.

ble to distinguish between the natural and artificial stone. I, an expert, have often been in doubt and had to make a close inspection of the building before I could decide.

There are in Europe some factories which turn out a fine product. The photographs of houses will show a few of those built by my father with cement stone in Germany

The ashlar in these buildings is made from cement plaster, while all the other ornamental work is made of art stone. These pictures show clearly with what success fine architecture can be erected at a saving of one-half, three-fourths and sometimes four-fifths the cost of natural stone.

In spite of the fact that this art stone is extensively used in that country, the public in general as well as the professional literature, or technical circles know as little about its manufacture as is the case here in America.

Every manufacturer keeps the manufacture to himself, a secret, and allows no stranger to inspect his works. Each working man is taught only one thing, so that in case he leaves the service to go to some one else, he is unable to do anything but what he has been accustomed to. When new works are opened the foreman is usually stolen by the offer of a large sum of money from some other factory and the firm is robbed of costly experiments which it took years and years to gain.

This industry is thus handicapped. When one tries to steal from another, each is injured, the business is ruined, and the public will say: "Cement stone is no good anyway, we will use natural stone."

The National Association of Cement Users, formed at Indianapolis, shows a spirit of assistance and mutual benefit.

Cement has a grand future ahead of it and will in a short time do much harm to natural stone and iron structure. But no doubt the old adage: "What is one man's bread is another man's death," will also come true here.

The most attacks come already from masons. Ask any stone cutter about art stones, and you will soon have proof. It is true that recently much bad work has been done, partly attributable to ignorance of the business, and partly to the fact that the forms and designs were clumsy and the builder had no technical knowledge or taste for beauty.

After viewing such clumsy buildings, the artistically educated architect hesitates before he is willing to try the new process.

If this mistrust is once overcome by good architects a new field will be open for cement, as well as for architects.

They will find more room for their talents, than is possible now with hand carving. It will cost little more to make the finest ornaments in any quantity with common labor.

Although the construction is very simple, to obtain good results is not so easy, and good art stone is in reality "Art Stone."

To reach this, many have in this and other countries spent large amounts of money in experiments, and some have gone to ruin.

For the benefit of humanity I desire to bring this new industry as a specialty before the public and to show approved systems by articles and illustrations to be published in Municipal Engineering and through private information.

ARTIFICIAL STONE WORK BY J. WILKES AND SONS, GERMANY.

EDITORIAL COMMENT

Prevention of Fire Losses.

Quality of Sand for Concrete.

Some Sources of Stream Pollution.

PREVENTION OF FIRE LOSSES.

The losses from fire in this country have increased so rapidly that they are finally awakening the fire insurance people as well as the public to the necessity of taking some steps to prevent the vast losses of working capital of property owners and of profits of insurance companies which occur each year.

There are so many parts to the problem and so many interests involved that no one organization or person has felt authorized or able to take up their study. The single property-owner is restricted in knowledge and opportunity to acquire it; the municipal official has, ordinarily, a tenure of office too precarious to enable him to carry his investigations far enough to be valuable; the insurance company despairs of its ability to influence the adoption of better methods. But increasing losses have demanded higher insurance rates. These have brought home to the property-owners the necessity of doing something, and the increasing difficulty of doing business and the frequent losses from great conflagrations have awakened the insurance companies to the advisability of doing something more than attempt to fix their rates to cover the increased fire losses.

In one sense the fire insurance company has little interest in reducing the fire hazards, provided the occurrence of fires and the magnitude of losses follows some fairly uniform law, for it simply collects from the property-owners enough money to pay these losses and the expenses of doing the business. In fact, so long as business is comparatively easy to get, a percentage of profit on high rates gives more actual cash for distribution in dividends, so that until the rates become so high that they set the property-owner to estimating the cost of carrying his own insurance, the company may not feel it worth while to spend much money on investigations of methods of reducing fire hazards. Its interest is rather in the determination of the actual average cost of this hazard than in reducing it.

For some years it has been necessary to lessen the difficulty of doing business in cities on account of the high rates, so that the insurance companies have established building regulations, giving the property-owners the advantage of reductions in rates if these regulations are followed. These regulations have been, however, quite as much for the purpose of reducing the exceptional fire hazards, thus reducing the number and extent of the pronounced variations from the average fire hazard, as for use in reducing rates.

Similar inducements are held out for other improvements, such as increase in number of fire hydrants, of fire pressure, and of amount of water supply in water systems, construction of fire cisterns, changes in exposures, etc. They have led to many such improvements, but have not had their full effect because the insurance companies are not in position to enforce their requests, and have not felt themselves called upon to make the fullest expert investigation, consequently some of their recommendations are not sufficiently well considered and do not appeal to the property-owners as practical and feasible, while the application of other propositions to individual cases is not made in proper manner and thus flaws can be found in a recommendation which on general principles is excellent. It is not surprising that single insurance companies or even associations of such companies would not feel justified in expending considerable sums for expert service and advice which would benefit them alone less than the expense of the work, although it would benefit the business as a whole incalculably.

The National Board of Fire Underwriters has done much in these lines and has recently begun a new investigation which should bring results. It is composed of 120 fire insurance companies and its purpose is to improve methods of building construction, and encourage fire protective measures, such as improvements of fire departments and water supplies.

This board has appointed a committee of twenty to organize an engineering department and that committee now has in the field four parties collecting data and making tests under the direction of Mr. E. G. Hopson, the chief engineer, a hydraulic engineer of many years' experience, and Mr. G. S. Curtis, an expert in the establishment and management of municipal and factory fire departments and their auxiliaries. The secretary of the committee, Mr. Herbert Wilmerding, is in direct charge of the details of the organization. The committee has secured the co-operation of the corps of engineers, United States Army, and the reports for each city will be reviewed by two of its engineers.

While it cannot be said that the fire insurance companies have failed to carry on investigations, it may, perhaps, fairly be said that this is the first fully organized attempt on an adequate scale to study the existing conditions and to devise methods of improving them. The purpose is apparently to make these definite and individual for each city as it is considered and reported upon.

The municipalities of the country are, perhaps, the most directly interested in the proper consideration of these questions of fire prevention and protection. They own or control more or less satisfactorily their water supplies with which to put out fires. They should control the methods of building, through their building regulations. They can, if necessary, modify the lay-out of their streets to reduce fire hazards. In short, they can control almost every item which goes to make up the total fire hazard, aside from the actual contents of the building, and even these are subject to some regulation.

Here also, no single city has felt itself justified in making the exhaustive studies necessary to produce the best possible regulations and methods of construction and operation. Then, too, politics will too often prevent the proper operation of its own fire department and water supply. The national government would be justified in establishing a department for the thorough study of all these questions, including tests of building materials and all things used in preventing and putting out fires, trial of methods of operation, investigations and reports upon individual conditions, etc. Such a bureau is without question the only agency through which a complete treatment of the subject could be obtained.

Until the need of such a bureau is more fully recognized we must be content with individual effort, with the engineering committee of the National Board of Fire Underwriters, and with the Columbia University Fire Testing Station, and other similar agencies.

It is, perhaps, hardly fair to mention the Columbia Fire Testing Station in this casual way for it has entered upon a work which, from the standpoint of the builder, is of the utmost importance. It is very young, however, its first publication of a test being dated Sept. 30, 1904, and its value is not yet widely known. The superintendent of the station, Prof. Ira H. Woolson, is working in co-operation with the building bureaus of the city of New York and his results are applied at once in the building regulations of that city. This makes it possible to secure improvement almost immediately upon the determination of the method of making it, and should lead within a very short time to very pronounced results not only in New York but in other cities which should feel themselves justified in following that city at the earliest possible moment.

QUALITY OF SAND FOR CONCRETE

The paper by J. C. Hain before the National Association of Cement Users, which was published in the February number of Municipal Engineering, shows the beneficial results of a proportion of fine dust, clay or loam in sand for mortar. The new edition of the "Handbook for Cement Users," now in the hands of the printer contains the results of other experiments which indicate the same improvement in strength of concrete by the addition of fine material to the clean, sharp sand of the ordinary specifications.

Mr. Hain concludes that the best natural mortar sand is one with sharp corners, rough surfaces, with proper mixture of coarse, medium and fine grains to produce the least percentage of voids and that clay in any quantity up to 12 per cent may improve it.

All these experiments were made on mortars made of one part cement and two and one-half to five parts of sand, except some made by Mr. C. C. Huestis. In a recent communication to Engineering News, Mr. Huestis states that he finds a better mortar of crushed sandstone containing dust, than when the dust is washed out, if the mortar is in the pro-

portions of 1 to 3, but when it is made of one part cement and two parts sand, the sand with the crusher dust washed out is the stronger. He found the same improvement in mortar when he added limestone dust or clay to washed river sand when the mortar was made 1 to 3.

Mr. Huestis has drawn the conclusion that the increase in strength of the 1 to 3 mortar is due to the complete filling of the voids in the sand by the fine material and that addition of the fine material to sand whose voids can be completely filled by the cement reduces the strength.

Tests of mortars with various proportions of cement, the results of which are given in the "Handbook," show, when platted on a scale proportional to the amount of cement in the mortar, that the tensile strength of the mortar is almost exactly proportional to the amount of cement in it, if it is 50 per cent or less, the variations being apparently due to irregularities in results of tests. If the proportions of the mortar are 1 to 2, the voids are certainly filled, unless they are greater than 50 per cent, which is not true in mortar sand. If the sand grains are uniform in size, the voids will probably not be filled with cement if the proportions are 1 to 3. The results of tests referred to show that if these voids are filled by the fine material the strength of the concrete is increased. To assume a case, take a sand with 40 per cent voids. If cement is added in the proportion of 1 to 3 it fills 33 per cent, leaving 7 per cent to be filled. If the cement is measured loose the percentage of voids to be filled is larger. If the filling of these voids by anything fine, even loam, increases the strength, as Mr. Hain's results indicate, it is fair to assume at least provisionally with Mr. Huestis that it is because the effect of the fine material in filling the voids is greater in increasing the strength than the effect of the quality of such materials in decreasing the strength of the mortar. It is also fair to assume with Mr. Huestis that the decrease in strength of 1 to 2 mortar is due to the effect of the diluting fine material upon the mixture, actually increasing the proportion of aggregate and thus decreasing the proportion of cement. If clay or loam is used it is also probable that the poorer quality of these materials for such uses has its share of effect in reducing the tensile strength of the mortar.

Mr. Hain's experiments were for commercial purposes and upon commercial sands and did not extend to the detail necessary to find the effect of variations in proportion of cement or in proportion of voids in the washed sand. It will be worth while for some laboratory to take up this phase of the problem.

SOME SOURCES OF STREAM POLLUTION.

The United State geological survey has just issued a report upon the disposal of strawboard and oil well wastes made by R. L. Sackett and Isaiah Bowman.

These are two special polluting matters for surface waters which are extremely difficult to handle and this report is a study of the methods used in treating them with suggestions for improvement. These particular classes of waste have not been considered in the English books on purification of trades waste and there are no American books on this subject.

Prof. Sackett describes the process of manufacture of strawboard and shows the great quantities of waste produced. He also shows the inefficiency of the present methods of purifying this waste and preventing the pollution of streams. Then follows the description of a number of experiments with various methods or treatment, at the close of which he draws a number of conclusions.

Strawboard is very stable when clean, but very foul and objectionable when mixed with sewage and other putrescible substances. It interferes physically with the spawning beds of fish and even with the fish themselves, and in some cases the lime in the refuse is enough to kill the fish. Simple sedimentation does not remove the light and very finely divided straw. Chemical precipitation with sulphates of iron and alumina, according to the usual methods, is effective, but very expensive on account of the large quantity of precipitants required and the cost of disposing of the sludge. Lime is of value as a precipitant. Filtration without sedimentation is impossible, but it may follow sedimentation advantageously. The most feasible treatment and the one nearest possible from the standpoint of cost is that with carbonic acid and milk of lime, which leaves the water clear and soft. No method of disposing of the sludge is proposed and it is shown that it cannot economically be

burned and the lime recovered for use again.

Mr. Bowman shows the drainage of oil and brine from the separating tanks at oil wells and to some extent from the wells themselves into the underground water supplies to their great detriment and recommends legislation to require this refuse to be drained to the streams so that it will not soak into the ground and reach the supplies of well water. Mr. M. O. Leighton calls attention to the fact that this course of procedure pollutes the surface waters, but asserts that they are already polluted with similar matter which cannot be removed and that much of the underground water also reaches the streams, so that it is not possible to remove all oil pollution from them. He, therefore, thinks that the underground waters, especially those from the rocks, should be protected, since they can be, and the pollution of streams to a greater extent be permitted because they cannot be kept pure enough in any event to be available for public water supplies.

This may be a good economic doctrine, but it is rather hard on the larger cities located on the main streams whose only available economical supplies of water are the streams into which the smaller oil-polluted streams flow. They are now in trouble over the oil in their filters and if the amount of this oil is increased as suggested their difficulties in filtration become insurmountable. If the owners of oil wells could be taxed to pay for the new supplies the cities must find or for the extra expense of purifying their present supplies, if any method of purifying them can be found, Mr. Leighton's argument might be applied, but, unfortunately these cities are outside the oil district and the laws do not now provide any means of distributing their damages over the people who cause them, and until it does make some such provision the proposed plan will not appeal to the sense of equity of their inhabitants.

THE QUESTION DEPARTMENT

BOOKS ON SEWAGE DISPOSAL.

This city will in a short time make contract with engineers to furnish a system of sewers. As we have no running stream into which to drain it will be necessary for us to use septic tanks. I am desirous of obtaining pamphlets or books containing authentic information as to the proper construction of septic tanks and filter bids in connection with them.

C. G. RICKER, Mayor, ——, Mo.

Rafter's "The Treatment of Septic Sewage" (50 cents), is a little book giving a general view of the subject and is probably the best for our correspondent's purpose.

Rideal's "Sewage and the Bacterial Purification of Sewage" ($3.50) and Dibdin's "Purification of Sewage and Water" ($6.50) are English books giving more detail and Baker's "British Sewage Works" ($2) is a new book giving short descriptions of typical English sewage disposal plants.

A list of articles describing septic tanks, which have appeared in Municipal Engineering, is given in vol. xxvi, p. 409, and another in vol. xxiv, p. 363. The following articles appeared in vol. xxvii:

"The Use of the Septic Tank in Ohio," p. 34; "Sewage Disposal," p. 335; "Sewage Disposal at Plainfield, N. J.," p. 37; "Sewage Disposal for Small Cities and Towns," p. 331.

MAKERS OF SEWAGE SCREENS.

We are anxious to know who manufacture screens to be placed around the intake to a sewage pump and within the pump well, preferably to be of rust proof metal or galvanized.

F. H. W., City Engineer, ——, Ark.

Any dealers in well supplies can probably furnish what is wanted. The following are suggested as nearest our correspondent:

Louisiana Machine and Well Works Company, Jennings, La.; the Crane Com-

pany, St. Louis and Kansas City, Mo.; Fairbanks, Morse & Co., St. Louis and Kansas City, Mo.; the Cook Well Company, St. Louis, Mo.; the St. Louis Well Machinery and Tool Company, St. Louis, Mo.

SPECIFICATIONS FOR CONCRETE SEWERS.

Kindly inform me where I can procure a set of good specifications for building concrete sewers.

F. D., Middletown, O.

Abstracts of specifications and descriptions of materials and methods of construction of concrete and reinforced concrete sewers will be found in Municipal Engineering Magazine as follows: For Washington, D. C., vol. xxii, p. 19; Coldwater, Mich., vol. xxii, p. 169; Wilmington, Del., vol. xxvii, p. 248; Indianapolis, Ind., vol. xxv, p. 182; Cleveland, O., vol. xxiv, p. 253. Copies of the detailed specifications in use in these cities can doubtless be obtained by application to the city engineers.

The new edition of the "Handbook for Cement Users," ($3.00), will also have specifications for concrete sewers.

SEPTIC TANKS AND SEWAGE FILTERS.

Can you give me the names of the cities and towns in Canada that are using the filtering and septic tank system?

W. S. G., Boston, Mass.

The only plants definitely known are at Vancouver, B. C., and Mt. Allison Univ., Sackville, N. B.

Toronto, Ont., has contracted for one and it is said that Winnipeg, Man., has something of this sort, but no definite information is at hand.

OPERATION OF CENTRIFUGAL PUMPS.

1. The outside and inside diameter of runner in a centrifugal pump being given, by what formula or rule can I find the least number of revolutions of pump required to cause same to begin to discharge under a given head to which water is required to be raised?

2. The size and length of suction pipe of a pump being given, also the difference of level between water supply and center of pump, by what rule may I find the greatest quantity of water that pump will discharge? What would be the effect on quantity discharged by increasing or shortening length of suction pipe?

3. What is the method employed for testing efficiency of a pump where means for measuring power, supply of water and head of discharge are given?

4. Where can I get a good short description of the current meter and its use?

H. I. DRAULIC,
——, Wash.

The answers to the first two questions depend upon the type of pump, slip, speed, etc., and cannot be answered definitely without much more information and more definite assumptions than those given. The quantity of water a pump will discharge depends upon the velocity of the pump. The maximum velocity will probably depend upon the point at which the driving belt will begin to slip. The catalogues of makers of centrifugal pumps give the velocities at which pumps should run under usual conditions to raise water to different hights. Thus a four-inch pipe should run, according to one table at 285 revolutions when lifting water five feet, 402 for ten feet, 901 for fifty feet, and 1,274 for 100 feet. According to the catalogue of another maker his four-inch pump should run for five feet lift at 335 revolutions for a discharge of 225 gallons a minute and at 550 revolutions for 450 gallons discharge; for ten feet lift, 410 and 605 revolutions for the same discharges, and for fifty feet lift, 930 and 1,260 revolutions respectively. The figures are given for each five feet of lift in the latter table and for each ten feet in the former within the limits stated.

Increase in length of pipe, number of bends or other obstructions to flow has the same effect as in any other case of flow of water through pipes.

In answer to the third question: The efficiency of a pump is the relation of the addition to the potential energy of the lifted water, to the energy actually applied to the driving belt of the pump in raising the water. The weight of water lifted in a minute multiplied by the hight of the lift and divided by 33,000 gives the horse power expended in useful work. The ratio of this to the horse power applied to the driving belt is the efficiency of the pump, without relation to the engine or boiler.

Excellent descriptions of the Price current meters will be found in Gurley's Manual. Johnson's "Theory and Practice of Surveying" has good descriptions of current meters and methods of using them.

SERVICE CONNECTIONS FOR WOODEN WATER PIPE.

We are intending to improve our water system and I have been investigating the merits of different kinds of water pipe.

Wooden pipe has been highly recommended, but I have recently heard that at Republic, Wash., with a pressure of 107 pounds to the square inch the iron plugs or nipples screwed into the wooden pipe for connecting service pipes often blow out when a hydrant is closed after a fire or fire drill. Sometimes house connections are made by means of brass nipple or bushings with coarse threads instead of iron. I think the brass ones would not rust, therefore would not be so apt to blow out. Can you inform me where I can get any data on the subject?

L. T., Cottage Grove, Ore.

The above question is referred to our readers. What methods have they used for inserting corporation cocks in wooden pipe under heavy pressure?

BOOKS ON CONSTRUCTION OF WATER WORKS.

Have you any book dealing in detail with the building of water works systems and laying water mains? Would like something containing a treatise on estimating, records of cost by engineers, etc.

ALBANY MATERIAL AND CONSTRUCTION CO., Albany, N. Y.

Folwell's "Water Supply Engineering" ($4) and Turneaure and Russell's "Public Water Supply" meet the requirements nearest of any of the American books.

SEPARATION OF GAS FROM WATER.

Several years ago our city auditor secured through your courtesy the names of several firms that manufactured apparatus for the separation of gas from water. We have here in this section artesian wells and coming up with the water are large quantities of gas. We at the present time lose about half of the gas, as it does not have time to separate as it passes through the receiver. Will you kindly furnish me with the names of the manufacturers of such apparatus and greatly oblige?

A. W. E., Pierre, S. D.

The names referred to are William Moor, Kokomo, Ind., and Reynolds & Johnson, Anderson, Ind.

HYDRANTS LIFTED BY FROST.

We have experienced a large amount of trouble this winter from the frost lifting the hydrants and breaking the branch which leads from the main to the hydrant. This necessitates a great deal of trouble and inconvenience, as it takes some time to repair the trouble on account of the depth of the frost, which has reached a depth of five or six feet this winter.

The hydrants are fitted with frost cases, but these seldom do any good. Can you or any of your readers suggest a method by which this difficulty can be overcome?

P. S. S., Montpelier, Vt.

This is a specially hard case in which the ordinary methods are not quite sufficient. Can our readers suggest anything better than special construction of frost cases and special depth of hydrant and branch? It ought to be possible to give all the movement due to the heaving of the ground to the frost cases, leaving the hydrants in place. It would be necessary to reset the frost cases more frequently than under ordinary conditions, and possibly it could not always be left until the frost was out of the ground.

EARLY CONCRETE DAMS.

We are anxious to know what was done in the way of concrete dam or hydraulic construction prior to the year 1897, and as readers of your medium we will ask you to refer us to any articles in your medium, or others, which may have any bearing on this matter. What we wish to know in point is whether any such concrete dams or hydraulic plants were successfully undertaken and completed prior to the year mentioned.

H. H. H., Montreal, Que.

No record of the use of concrete for making dams earlier than the date mentioned has been found after some search. Can our readers refer us to any?

COST OF WOODEN WATER PIPE.

Please give me the cost per foot of wooden stave pipe 18, 20 and 24 inches in diameter; also the probable life of the same. Speak of its economy, if any, as compared with the above sizes of iron.

——, Greensboro, N. C.

Reference should be made to Municipal Engineering, vol. xxiii, p. 261, and vol. xxiv, pp. 279 and 365, especially the last named, for data concerning wooden water pipe and its cost. Twelve-inch pipe bids are quoted at 78 cents a foot. A manufacturer of wooden stave pipe quotes 80 cents for 12-inch, $1.30 for 20-inch and $1.50 for 24-inch. This is much less than cost of iron pipe. Durability is discussed

in vol. xvii, p. 296, where the conclusion is reached that except for renewal of steel bands the pipe is more permanent than iron if in constant use. The questions of relative cost and economy must be determined for the local conditions.

HOT WATER HEATING PLANTS, CONCRETE STEEL BRIDGES.

Will you kindly give us the names and addresses of Yaryan and E. A. & Co., mentioned in the table of statistics of central station heating plants using water and steam, which was published in your January number?

Can you tell us where we can secure some pamphlets on concrete-steel bridges that we may distribute among some of our friends who have bridge contracts to let? I. I. W., Clinton, Mo.

The Yaryan Company is at Toledo, O., Evans, Almirall & Co. are in New York City.

The firms whose names are given in the "Business Directory" printed in each number of Municipal Engineering, under the headings "Bridges," "Concrete-Steel Arch Bridges," "Expanded Metal Construction," will doubtless be willing to supply circulars which will answer the purpose of disseminating information about reinforced concrete.

INDEX TO MUNICIPAL ENGINEERING.

As to your getting out of that card index to the magazine I hope you will make up your mind to get it out soon. I, as well as many others, want it.

L. C. H., ——, Wash.

The responses to the inquiry regarding the demand for an index to Municipal Engineering have been few and its publication has not yet been decided upon. It will probably not be a card index, the expense even of one in book form promising apparently to be much more than the return from it.

BOOKS ON BUILDING CONSTRUCTION.

I am anxious to find a book which will give specifications for building houses, one that will tell the amount of lumber required, etc.

S. T. C., Fayette, Mo.

The following from a list of books on building construction probably come nearest to what is wanted:

Clark's "Building Superintendence," ($3).

Kidder's "Building Construction and Superintendence," part II, carpenters' work ($4).

Martin's "Details of Building Construction" ($2).

"The Carpenters' and Builders' Complete Companion" ($2.50).

Plummer's "Carpenters' and Builders' Guide" (75 cents).

Any books desired can be supplied by Municipal Engineering at the list prices.

PLANS FOR SCHOOL HOUSES AND CONCRETE BLOCK BUILDINGS.

Do you know of a book of plans for school buildings, and can you introduce me to a firm that will be likely to supply up-to-date plans for a cement block building?

J. M., New Liskeard, Ont.

Briggs's "Modern American School Buildings," ($4.00), Clay's "Modern School Buildings," ($10.00), Gardner's "Town and Country School Buildings," ($2.50), and Wheelright's "School Architecture," ($5.00), are suggested as answers to the first question, and doubtless what our correspondent desires can be obtained from one or more of them. Briggs gives 412 pages and 89 pages of illustrations. Clay gives plans for eighty-five schools and many details and fittings. Wheelright's book is a general treatise.

In reply to the second question, the names of Louis H. Gibson, Law Building, Indianapolis, Ind., and Paul Wilkes, 24 Wick Block, Cleveland, O., may be added to those of architects paying attention to concrete blocks as building material which have been published in this department in recent issues. Reference may also be made to the "Business Directory" printed in each number, under the headings "Architects" and "Civil Engineers."

LITERATURE ON CEMENT BLOCK CONSTRUCTION.

I have a notion to engage in the manufacture of cement building blocks, but would first like to read up on the subject and for this purpose would ask you to select for me such back numbers of your publication as will give me the desired information, as far as it is accessible. If there are any books written on the subject let me know.

F. L. W., Hermann, Mo.

There is scarcely a number of Municipal Engineering for the past two years which does not contain something of in-

terest in the line mentioned. In fact, the back numbers for the past three years are the only volumes in which the processes of making cement blocks and the machinery are fully described. Hagloch's "Art Stone" ($1) is the only book published on the subject at this date. A subscription to Municipal Engineering at $2 a year, beginning at any time in the last three years, will be the best investment.

ARTICLES ON PORTLAND CEMENT MANUFACTURE.

Kindly give references to articles on Portland cement manufacture in your magazine. L, ——, Mich.

The following is a partial list of articles on Portland Cement manufacture appearing in Municipal Engineering, giving the most important of these articles. In the reverse order of their appearance in the magazine these articles are "Portland Cement Crushing and Grinding Machinery," October, 1904, page 250.

"Hydraulic Limes and Grappier Cements," September, 1904, page 168.

"Cost of Building and Operating a Portland Cement Plant," June, 1904.

A series of articles on Portland Cement manufacture by E. C. Eckel as follows:

"Clinker Grinding, Gypsum," April, 1904.

"Burning the Mixture," January, 1904.

"Preparing the Wet Mixtures for the Kiln," December, 1903.

"Preparation of Slag, Limestone Mixtures," October, 1903.

"Preparation of Dry Materials for the Kiln," September, 1903.

"Excavation of the Raw Materials," August, 1903.

"The Raw Materials," July, 1903.

An introductory paper on "Portland, Natural and Puzzolan Cements," May, 1903.

A series of articles on natural hydraulic cements by Mr. Eckel has appeared in the numbers for December, 1904, and March and April, 1905.

ESTIMATING COST OF BUILDINGS.

I see somewhere a book on figuring buildings by the foot for estimating. Can you inform me where I can procure such a work. C. W. A. D.,
Newburyport, Mass.

Kidder's "Architects and Builders' Pocket Book" ($5) is probably the book desired.

MUNICIPAL MANUAL.

The writer has seen—when and where, he does not recall—a directory of cities and towns containing full information regarding each town's government, water works, lighting plants and all such institutions of public character.

We are very desirous of getting this, or similar work, in order to get full information about water works plants in Texas and Louisiana, and it has occurred to us you are probably able to advise where same may be found.
H. W. M., Beaumont, Tex.

The "Municipal Manual" ($3) is the only publication giving all the information asked for; the "Manual of American Waterworks" ($3) gives fuller detail about water works systems.

BOOK ON DRAWING—COST OF CEMENT.

Can you refer me to some work making a specialty of instruction in drawing steel shapes and structural design?

What should "A1" Portland cement cost here? The local dealers ask $4. Is that not two or three times a fair price? I have seen statements that it is manufactured at a cost of from 60 cents to 80 cents per barrel. Packing, shipping and commission should not run price up so much. OKLAHOMA READER.

Such books as Coolidge's "Manual of Drawing" with a steel company's handbook, such as the Cambria or Carnegie, may be sufficient. Such books as Skinner's "Details of Bridge Construction" ($3) give reproductions of drawings of many details.

It may not cost more than 60 to 80 cents to manufacture Portland cement in a plant under the most favorable conditions as to cost of raw material and its delivery and cost of fuel, especially if it is natural gas, but the average cost of manufacture is probably somewhat above the larger figure. The Central Cement Manufacturers' Association, made up mainly of manufacturers of marl cements, has recently advanced prices ten to fifteen cents and now expects to get $1.21 a barrel from jobbers at the mill. This is not a very unreasonable price and gives a fair margin to all manufacturers and a very good one to others. The freight rates to Oklahoma are not definitely known, but would probably be from 30 to 40 cents a hundred from plants most likely to ship to that district, making jobbers' prices in Oklahoma say $2.50 to $3 a barrel. With the cost of local sale and de-

livery added the price of $4 for small quantities does not seem to be very far out of the way. Local inquiry regarding freight rates on brands in the local market will enable our correspondent to correct these estimates to suit his own locality.

PRACTICAL SMOKE PREVENTION.

Would you please tell me if there is such a thing as a practical smoke consumer, and in what city is it used?

R. C. W., Nashville, Tenn.

Mr. R. P. King, Consulting Engineer, who is the smoke inspector for the city of Indianapolis, recommends the following means of preventing smoke, which are found to be more satisfactory than attempts to consume smoke already formed.

The Green, American, Jones and Victor mechanical stokers; the Automatic and Sharp smoke preventers and the Dorrance furnace. He adds as probably the best method of preventing smoke the use of Pocahontas smokeless or anthracite coal.

SYSTEM OF HOUSE NUMBERING.

Can you tell me whether any system of house numbering has yet been devised that is superior to the Philadelphia sys-system? Our city is very irregular and streets in some instances have several more blocks on one side than the other, while parallel streets often have different sized blocks. Can you explain how the Philadelphia system numbers irregularly laid out plats?

GEORGE H. RANDALL,
Oshkosh, Wis.

This question is quite fully discussed in Municipal Engineering, vol. xxiv, p. 104, and a method of applying the rectangular or Philadelphia system to a comparatively irregular town is worked out. The city of Indianapolis is partly regular and partly irregular, partly rectangular and partly with park or surburban curved and irregular streets. The rectangular system of numbering has been extended over the irregular sections. The only error made was in assigning a single number to a lot so that when more than one house is put on the lot half numbers are often necessary. If the hundred numbers belonging to a block are distributed more liberally there may be some missing numbers when the block is new, but if there is any subsequent filling up these numbers will be ready for use without interfering with those first assigned.

THE SUCCESS OF THE INDIANAPOLIS CITY CHARTER.

Knowing your interest in municipal affairs, I take the privilege of asking you a few questions concerning the government of Indianapolis.

1. Is it not an efficient system of municipal government?
2. Are not the people satisfied with their present government?
3. Is continuity of administration maintained? Especial reference to subordinates.
4. Are the mayors capable and honest, as a whole?
5. Are the rules of civil service regarding subordinates obeyed?
6. Is there any corruption under the present system?

A. C. McGILL,
Grinnell, Iowa.

1. The system of municipal government in Indianapolis seems to be the most efficient with which the editor has been acquainted.

2. The people are so well satisfied with the present method of government that when the Codification Committee appointed by the Legislature two years ago, presented a general bill for the government of the cities of the State, which did not agree with the Indianapolis charter, they brought pressure to bear upon the Legislature to modify the bill so that it now, as enacted into a law, follows the charter of Indianapolis as closely as the circumstances in cities of different sizes will permit. The cities in the State are divided into classes according to size, and in all essentials are governed as the city of Indainapolis has been governed for the past fourteen years, the details being changed to conform to the requirements of size and amount of business.

3. Continuity of administration is maintained only through the election of the same mayor for subsequent terms. Heretofore the term of the mayor has been two years, but the new law changes it to four years.

There is a civil service regulation of the police and fire departments which makes the subordinates in these departments permanent in their places, with the exception of a very few, who come close to the line of inefficiency, and are changed when the new administration comes into power. There is now a similar regulation with reference to the health department, and to some extent the building inspection department. Otherwise civil service

is not in force in the city, although under the charter it is possible.

4. The Mayors, since the charter was first established, have, as a rule, been capable and efficient. It would scarcely be possible to carry on municipal government without expressions of suspicion of the honesty of officials, and actual investigations of such allegations regarding subordinates have been made without positive results. The city is so close in its political balance that it is seldom difficult to oust an administration, which has not given satifaction, at the end of its term.

5. The rules of civil service, as far as they exist, as referred to in answer to question three, are obeyed, with very few exceptions in spirit and with none in letter.

6. There has been in two administrations some question as to the honesty of city officials, but I think there has seldom been any suggestion that city funds are diverted to private pockets. Any corruption which has been suspected has been rather in the way of bribery in the letting of franchises or the protection of vice. There has been very little of either, and the investigations spoken of have nearly all been of this class of accusations.

The adoption of the Indianapolis charter marked a new era in city government in this country, and the principles on which its charter is based are being recognized more fully each year and there are now several cities which have more or less close approximations to the Indianapolis charter in addition to the cities of the State of Indiana which will begin to act under their new charter in May of this year.

FORM AND DIMENSIONS OF RACE TRACK.

I wish to lay out a half-mile race track and would be obliged if you will give length of curves; radius, and whether they are semicircles; elevation of outer edge; length of straight part; whether measured outside or inside; width of track; grade on different sections, and whether length is full 2,640 feet?

J. A. W., Lexington, Mo.

Baker's "Roads and Pavements" ($5) gives the only full description in book form of methods of laying out race tracks. The standard half-mile track oval has two straight stretches, each 660 feet, and two semi-circular curves, each 660 feet long and 207.08 feet radius, thus putting the parallel sides 414.16 feet apart. The length is measured on the pole line and the inside fence line of the track is three feet inside this line. The track is 40 feet wide, except the side next the grand stand, which is 65 feet wide. Easement curves are sometimes used. The outer edge at center of curves is 3.4 feet above the inner edge, and only enough to drain the track on tangents, say 0.4 to 0.8 feet for 40 feet width. The track is made as nearly level as practicable. Some claim a slight advantage if there is a little grade, more slight on the way up as the horse travels round the track than on the way down. One noted track has a rise of 16 inches in the first quarter mile and 24 inches in the second, with a fall of 30 inches in the third quarter and 10 inches in the fourth.

Another half mile track has tangents 697.5 feet long and two semi-circles each 622.5 feet long and radius of 198.1 feet. Sometimes tangents are not parallel and circles are therefore of different radii.

Reference may be made to Municipal Engineering, vol. xxiii, page 29, for further details.

INDIANA CITIES HAVING BITULITHIC PAVEMENT.

I want to go west to Iowa through the greatest number of cities and towns having Warren Brothers' bitulithic pavement for purpose of inspecting it. I have a list of Michigan towns having the pavement.—C. S. M., Iowa City, Iowa.

The cities in Indiana having bitulithic pavement are all in the north, Montpelier, Bluffton, Huntington and East Chicago. A contract has recently been let for a bitulithic pavement in Indiandianapolis. If the trip can be extended as far south as St. Louis the largest amount of this kind of pavement in any city can be inspected.

MICA AND INFUSORIAL EARTH.

Will you please inform me where I can buy mica in soluble form or powdered form and at about what price? Will you also tell me where I can buy infusorial earth, and how expensive?

F. C., Colon, Mich.

There are numerous dealers in ground and pulp mica, of which the following are a few:

In New York City, Francklyn & Ferguson, Cotton Exchange Building; National Gum and Mica Co., 502 W. Forty-fifth-st.; W. H. Whittaker, 245 Front-st.; Atlas M.

& M. Co., 82 Pearl-st.; also the Richmond Mica Co., Richmond, Va.

The Infusorial Earth Mfg. Co., 218 E. York-st., Baltimore, Md., is the only name listed as dealing in this material.

Quotations of prices are not at hand.

PAPER SACKS FOR CEMENT.

We are desirous of obtaining the names of some of the cement dealers who use paper sacks. We recently bought one of your directories of the cement industries, but are unable to find out just which ones use paper sacks and which ones do not. Can you aid us in obtaining this information?

H. D., Chicago, Ill.

Cement is almost always put into sacks by the manufacturers so that there is little or no trade in paper sacks with cement dealers directly. The manufacturers will ship cement in barrels, paper, cotton or jute sacks as ordered and the tendency is toward paper sacks except for long haul shipments and where specifications fix the kind of package. The sacks bear the trade-mark of the manufacturers, an additional reason for filling them at the factory rather than at the dealer's warehouse.

WHITE PORTLAND CEMENT.

We are in the market for some white Portland cement. Will you kindly inform us if there is any place in New York where we can purchase it?

B. L., New York City.

Can you let me know what Portland or puzzolan, domestic or imported, is the lightest in color; something on the order of the Steel Portland cement of the Illinois Steel Company?

C. E., St. Louis, Mo.

Reference may be made to Municipal Engineering, vol. xxvii, p. 187, for suggestion as to method of making comparatively white mortar for concrete and a list of American Portland cements which have shown themselves in practice to give good results as to color. There are still others.

Mr. Charles Zunz of Brussels, Belgium, and New York City sends samples of very light colored puzzolan cements which are described in the same article.

J. Lecomte, Mexico, Mex., also states that he has a white Portland cement on sale, but does not give its composition.

Lafarge cement is a French "grappier" cement which is non-staining and light in color.

The puzzolans manufactured in this country are "Alabama" and "Magnolia" made by the Southern Cement Company, Birmingham, Ala.; "Clarkes," "Toltec," "Rhinoceros" and "Patapsco," made by the Maryland Cement Company, Baltimore, Md.; "Climax," made by the New Jersey Portland Cement Company, Perth Amboy, N. J.; "Struthers," made by the Struthers Furnace Company, Struthers, O. We must refer the question of their relative whiteness to our readers who have used them.

CONCRETE FOR SILOS.

We are having inquiries relative to the construction and feasibility of concrete silos.

B. & J.,
Manchester, Ia.

There is no serious difficulty in the way of making silos of concrete. They may be made of blocks or of solid concrete. The question of reinforcement arises and would be settled for any particular case by the hight of the silo and the amount of horizontal pressure expected. Steel wire or bands may be used in a wall built of blocks and any of the ordinary methods of reinforcement in a solid concrete wall. It is desirable to have the walls as nearly air tight as possible and this can be attained by proper proportions of cement and care in placing same in molds or in making blocks. A plastering on the inside of the silo will probably be needed also.

For names of firms who can build silos and furnish information about their cost reference may be made to the "Business Directory" printed in each number of Municipal Engineering, under the headings, "Concrete Work," "Expanded Metal Construction," "Monolithic Construction."

CEMENT FLOORS FOR FACTORY BUILDINGS.

Can you refer us to any issues of Municipal Engineering in which the subject of concrete or cement flooring for factory buildings is treated? We are about to put up a large building and want to investigate the merits of cement flooring as compared to the usual lumber construction.

H. & CO.,
New York City.

There are many articles on the construction of cement sidewalks and floors, which are similar in composition and methods of laying. Among the articles

of most interest to our correspondent may be mentioned the following:

"Concrete and Concrete-Steel in the United States," paragraph on floors, vol. xxvii, p. 444.

"How to Lay Cement Walks and Floors," vol. xxvi, p. 246.

"How to Replace Cement Floor Surface," vol. xxiv, p. 32; vol. xxii, p. 162.

"Concrete Floors for Stables," vol xxii, p. 266.

"Cracks in a Cement Floor," vol. xxii, p. 167.

"Floors for Wet Cellars," vol. xxi, p. 230.

The "Handbook for Cement Users" ($3) also has much excellent information on the subject of cement floors and their construction.

HOW TO CONSTRUCT A SWIMMING POOL.

Would you please tell me where I can procure any reading matter in relation to building a swimming pool? The size is to be about 35 by 70 feet by a depth of 3 to 7 feet. W. S. G.,
Ocean City, N. J.

If the pool is to be made of concrete, the descriptions of the methods of construction of reservoir linings and bottoms, concrete walls, etc., could be applied thereto. They will be found in the "Handbook for Cement Users" ($3) a new edition of which is now in preparation, and in Municipal Engineering. A photograph of the pool at Ocean Grove will be found in vol. xxiv, p. 427, and a part of one at Erie, Pa., made on the shore of Erie Harbor is shown in vol. xxv, p. 415. This is open on one side to the harbor. The Milwaukee natatorium is described in vol. xxviii, p. 12. Its swimming pool is of brick. Reservoir linings of concrete, brick and sand lime brick are shown in vol. xxvi, p. 228. Other articles will be found in earlier numbers.

CONCRETE STREET PAVEMENTS.

Will you kindly favor me with such information as you possess as to what success concrete construction has had when used in street or alley pavements?
H., Chicago, Ill.

The earliest concrete pavement in this country with which the writer is acquainted is that at Bellefontaine, O., laid about fifteen years ago. The specifications for this pavement are given in Municipal Engineering, vol. iv, p. 229, also in vol xix, p. 427, and some photographs of the streets will be found in vol xvii, pp. 383 and 384. This pavement is still in fairly good condition.

A description of a similar pavement in New Orleans in quite different conditions will be found in vol. xx, p. 341, with illustrations. This pavement is reported to be less successful.

A description of a new concrete pavement on a narrow street in Grand Rapids, Mich., with an abstract of the specifications will be found in vol. xxiii, p. 400, and a photograph of the street is reproduced on page 335.

Concrete pavements in Toronto, Can., are described in vol. xxvii, p. 350. This article gives cross sections of the streets laid and full information regarding methods of construction and the success of the pavements during the short time they have been in existence.

There is some discussion of the success of concrete macadam pavements abroad in vol. xxi, p. 22, and of concrete block pavements in Germany in vol. xxvi, p. 275.

An article in this number describes the new concrete pavements in Richmond, Ind.

FOUNDATION FOR CEMENT WALKS AGAIN.

In the time allotted at the N. A. C. U. we could not do justice to the matter of laying cement walks and I am glad that Municipal Engineering is giving so much space to this matter.

There are many of the difficulties which the contractor has to contend with that were not mentioned in the paper of Mr. Gridley or in the discussion. I think Mr. Gridley's specifications as a whole were the best I have read. The contractor often has walks to lay on clay ground with but little or no way of drainage. On such ground it is not advisable to dig a pit to fill with water which would be worse than the natural soil for frost to heave. I agree with Mr. Perdue, lay the walks in such places on the soil.

After seventeen years' experience with cement walks I have learned that the grading of the lawn at the sides of the walk is as important as foundations. Grade one inch below the walk, and the lawn on the street side should be the same slope as the side walk so that no water will remain on the walk.

I have found the sand separation for the blocks the best, being careful to cut the top coat open after running the jointer so that the blocks will work independently in the heaving by frost. Walks

laid in this manner will seldom be cracked by action of the frost as the walk and ground at the sides will rise at the same time, so that there will be no danger of cracked blocks or uneven blocks.

Another mistake that is being made by both the property-owner and contractor is cheap work. The property-owner cannot afford it on account of the risk of poor walks that will have to be replaced sooner or later and the contractor will lose the confidence of the best paying owners in consequence. As a rule property-owners are willing to pay enough for good work so that the contractor will have a living profit. That being a fact, why should the contractor hazard his reputation by doing poor work even if the property-owner does not offer enough for such work so that there will be a living profit left? A side walk can be built so that it will stand common usage until the contractor can collect his pay, but the first runaway team or fire wagon over it and the winter's frost will make it a candidate for replacement. The writer has replaced several such walks and has always been told to build a good serviceable walk at a living price.

Another mistake that has been made by many engineers and contractors is not using enough cement in the bottom coat. Some sand and gravel will make as strong work with 1 cement to 7 gravel as finer sand and gravel 1 cement to 4 gravel. The writer has found that it is not safe to use less than 1 cement to 5 gravel.

In many parts of the United States side walks are not laid thick enough. Many reason that because Portland cement concrete is harder than sandstone it is not necessary to be thicker than stone walks are usually laid. The fact that Portland concrete is harder makes it not so elastic as stone, and consequently more liable to break by either blows or frost. From the writer's observation two-inch stone will not break under the same strain from frost that four-inch concrete will, so consequently Portland cement concrete should not be less than four inches in thickness. Some may think this is argument in favor of stone, but as it has been proven by comparisons side by side that Portland cement walks wear about six times as long as stone, the property-owner will have cement on account of its wearing qualities. In Cleveland, O., where sawed paving stone are probably the cheapest of any place in the United States, Portland cement walks are being laid in front of nearly all the business blocks, and in many of our northern towns where Portland cement walks have been in use from twenty to twenty-five years but little paving stone has been laid during the last eight years notwithstanding all the effects of poor work done by unreliable contractors.

The success of Portland cement walks largely depends on the responsible contractor guaranteeing his work to be strong and durable and then being careful to do only such work as he can guarantee.

GEORGE L. STANLEY,
Ashtabula, O.

The editor's reply or criticism of my article on deep excavations, etc., in the March number I have carefully read two or three times, but somehow I fail to understand it. It seems to answer only from the viewpoint of a writer or theorist instead of actual experience, in other words I don't believe he ever laid any walks. L. F. PERDUE.

The editor wrote his comments in Mr. Perdue's letter in the March number of Municipal Engineering, page 225, in the light of some fifteen years' experience in making plans and specifications for work of various kinds using cement and supervising the construction of the same, including many miles of sidewalks, and in investigating the causes of failures in cement walks under a variety of conditions, none of which, fortunately, occurred on his own work. He admits promptly that he has never laid any walks as a cement worker or contractor, but sets against that class of experience the opportunity to compare conditions and quality of work which he has had. His principal point, stated in as few words as possible, was that a city's specifications for cement walk construction must be fixed and, therefore, they must be strong enough for the worst conditions likely to occur. A private person can make more flexible specifications without danger of accusations of favoritism for certain contractors or financial interest in the profits, if he will watch his work close enough and knows enough about it to be able to judge when the cheaper construction is safe, and whether he is getting the full benefit of the reduction in cost of construction.

Another point was that water must be all drained off, leaving the foundation of the walk as dry as possible. If water reaches the foundation in any way it leaves it damp, after it is drained off. The foundation must be porous enough so that this small residuum of moisture, when it expands in freezing, will have room to expand without lifting the earth and the walk. He may have been unfortunate in his way of stating these points last month and possibly is equally so this month, but he stands by the theoretical principle on which they are based because it is borne out by observation of the actual facts.

Mr. Stanley's suggestion that the blocks

of the sidewalk should be free to rise and fall with the heaving and settling of the adjoining soil may be followed in case nothing better can be done, but the writer has found very few cases in which good drainage could not be obtained at reasonable cost and points to walks out of line and grade as basis for his opinion that it is worth the additional cost to give the walk a foundation of sufficient porosity, and complete drainage and to construct it so that the heaving of the adjacent soil may go on without interfering with the position of the walk either vertically or horizontally.

THICKNESS OF HOLLOW CONCRETE BLOCK WALLS.

Will you kindly advise me in regard to the width of a hollow block wall for use in two and three-story buildings. What size foundation block for two-story dwelling and what size for second story of business room and also for third story. I want to know the size or width of wall to make a substantial and safe building.

C. B. D., Sidney, O.

The thickness for a hollow concrete block wall has not yet been definitely determined. It is generally assumed that a hollow block is fully as strong, so far as crushing is concerned, as a brick wall of the same area of cross section, i. e., a 12-inch block will equal a 12 or 13-inch brick wall. This statement does not take into account variations in size of hollows nor in density and strength of the concrete in the block. The building regulations of prominent cities require in two-story mercantile buildings, 12 or 13-inch walls for the second story and 12 to 18-inch walls for the first story. For three-story buildings they require 12 to 16-inch walls for the third story, 12 to 18-inch walls for the second story and 13 to 20-inch walls for the first story. In Chicago the requirements are 12-inch wall for basement and 8-inch for one story; 12-inch basement and first story and 8-inch third story; 16-inch basement, 12-inch first and second story and 8-inch third story, etc., for residences, tenements, hotels and office buildings.

Some block machine makers recommend thinner walls of their blocks than those given above for brick, but they do not take sufficient account of the lateral stability of the wall and the eccentric loading occasioned by the usual way of placing joists on the inside section of the block thus requiring the inner half of the block to carry the floor weight. This may be safe so far as crushing strength is considered, but it requires a certain thickness in the walls to insure their lateral stability, especially under shocks or the special strains coming when floors give way under loads or in fires. This stability will probably exist if the walls are made of the same thickness as brick walls. There are very few hollow concrete block buildings four stories in hight, so that the problem of bonding a wall made of two courses of blocks has seldom arisen. It is an important one requiring careful attention.

PLASTERING ON CONCRETE BLOCKS.

We would like to get reliable data through the medium of your journal as to the safety of plastering a concrete block house directly against the walls, without furring.

We believe we have a reliable waterproofing that will absolutely prevent absorption of moisture from the outside, but we are afraid of sweating, so-called, or the collecting of the moisture from the air in the house, owing to the difference in the temperature between the wall surface and the air inside. We would like information as to wether it would do this in a sufficient degree to affect either plaster or paper. D. F. M., ——, Pa.

What definite results can our readers report? It was assumed in the beginning of the block business that plastering could be put directly on the block surfaces, but this was soon found to be dangerous for the same reasons that it cannot be done on a brick or a stone wall. First, because the blocks absorb water in the same way that a brick does, and second, because a cold wall bounding a room with a warmer moist atmosphere will cause water to gather on the pastering. The first difficulty can be overcome by making the wall water proof, either by water proofing the blocks and the joints or by making the wall hollow and with slight, if any, absorptive connections between the wall sections. The second difficulty can be overcome by using the hollow space in the wall as a ventilating passage for the room so that the inner section of the wall will become warmer than the outer section, or by painting the inner surface of the walls with a non-conductor of heat to which plaster will adhere. See also answer under heading, "Moisture on Block Walls."

It is probable that successful methods of plastering concrete block walls depend

upon the existence of one or more of the conditions named. Reports of observations of actual conditions will be published if sent for that purpose.

SALT IN SIDE WALKS.

The writer has successfully used salt for seven years by dissolving about eight quarts to fifty gallons of water and wetting the batches with it. Should the sand and gravel be wet, a portion of the salt, dry, may be added to the cement and be mixed dry.

The setting and hardening of the cement takes place much more rapidly so that walks can be opened for use several days sooner in cool weather than when salt is not used.

Where salt has been used in this manner the walks wear smooth and are strong and durable. I have laid walks as late as Dec. 15 in front of business places and opened the walks to the public in a week after being laid.

GEORGE L. STANLEY.
Ashtabula, O.

Mr. Stanley's experience is interesting and it does not agree with that of many previous experiments. Salt water has been used for mixing concrete in freezing weather for many years and rules have been devised for determining the amount of salt to use. The "Handbook for Cement Users" ($3) gives one fixing the addition of salt at 1 per cent of the amount of water for each degree of temperature below freezing. The usual report is that the setting of the cement is delayed, probably by the cold, but the prevention of freezing on account of the lower freezing point of the salt water gives time for the setting to take place. Have others among our readers had experience in this line? What is the effect of the salt upon the strength of the concrete? Does it dissolve out later, and if so does it tend to make the walk porous?

SEA SAND FOR CONCRETE.

There has been a great deal of discussion in our city concerning the use of salt water beach sand and gravel in municipal work. As I understand it, beach sand and gravel is not used on government work. Will you please discuss in Municipal Engineering the use of beach sand and gravel in concrete walks and walls. If not desirable, why should the use of these materials be prohibited?

C. A. L., Bellingham, Wash.

Sea water affects objectionably concrete made with ordinary Portland cements, especially those contafning magnesia, causing them to disintegrate on the surface in the course of time. Very few cements will withstand the action of the salts in sea water. Some slag cements have been used with apparent success in marine construction. The disintegrating action is slow and not of very great importance in massive structures except on the outside. Sea sand and gravel contain these same salts and in the comparatively thin and light structures mentioned will have an objectionable effect. In fact, in a massive structure it would distribute the objectionable ingredients through the mass and thus produce more serious effects than would the sea water itself if confined to the outside of the structure.

The washing of the sand and gravel might be suggested as a means of preventing the effect described, but it could easily increase the cost of the sea sand and gravel above that of more suitable materials more difficult to obtain. Moreover, the roundness of the grains of sand is quite a serious objection, the strength of mortars made of round-grained sand being, according to most experiments, less than that of mortars with sharp sand. There is little information on the subject and our readers are invited to contribute what they have.

MAKERS OF CONCRETE ROOFING TILE.

Kindly give me all the information you can concerning cement roofing tile. Also the addresses of parties who manufacture machines for making the same.

L. H. M., Ill.

In Municipal Engineering for February, 1905, page 174, will be found some statements about reinforced concrete roofing tile made on the United States Cement Shingle Machinery Company's machines. A picture of the machine will be found in the advertising section. Bedford & Nugent, Evansville, Ind., make cement shingles.

WHO SHALL LAY CONCRETE BLOCKS?

There are many reports of difficulties with trades unions regarding the laying of concrete blocks. In one instance the contest is between two trades unions as to which shall lay the blocks; in another case the brick layers have a union and the stone masons do not and the union has set up a scale for laying concrete

blocks which is practically prohibitory; in another the mason's scale is less than the bricklayers, but the latter claim the right to lay the blocks.

So far as standard blocks are concerned the work is more nearly that of bricklayers than stone masons, but when special forms of stone are used about windows, doors, etc., the work approaches that of masons though never far from that of bricklayers. If the business continues to develop at its present rate there will soon be a call for a union of concrete block layers or of concrete workers which will take the work off the hands of the other unions. In the meantime many of our readers will be interested in reports of the experiences of others and they will be published, without names, if preferred, if they are sent for that purpose.

HAIR CRACKS IN ARTIFICIAL STONE.

Mr. Albert Moyer, manager of the sales department of the Vulcanite Portland Cement Co., New York City, contributes the following to the discussion of the question of hair cracks or crazing in the surface of cement blocks:

The theory has been advanced, and with reason, that surface checks, hair cracks or crazing is primarily due to an excess of neat cement collected on the surfaces. This excess is probably the finer particles which have worked to the surface through the action of surplus water, which, being absorbed by the sand molds or the atmosphere, is drawn from the interior and carries with it the flour of the cement to the exterior of the stone, where it is collected, forming a matrix. This matrix of neat cement being exposed to sudden atmospheric changes and being more sensitive than the body of the stone, crazes in much the same manner as the glaze on porcelain. This crazing of neat cement is evidenced in test pats for laboratory purposes. It will be noted that when these pats are exposed to an uneven temperature during the process of setting or for several days after, they show these cracks and crazing, but if they are protected in a moist closet at an even temperature, absolutely no hair cracks or crazing result.

It is probable that the remedy lies in using less cement, only a sufficient quantity to furnish the necessary bond between the particles of sand or crushed stone. The stone must then be protected carefully during the time of setting and for a number of days thereafter. See that the temperature is as even as possible, that sudden drafts of cold air are avoided and that the proper time for seasoning is allowed. If it were possible to keep the stone entirely under water for thirty days at an even temperature, it is altogether likely that the entire trouble would be avoided. Another and easy remedy is to brush off this cement matrix with a steel brush. If this is done thoroughly there will be no checking, hair cracks or crazing.

CAN PORTLAND CEMENT MORTAR BE SOFTENED FOR REMOVAL?

Could you, or any of the readers of Municipal Engineering tell me what to use to soften Portland cement used in fastening insulators together? The insulators are made of porcelain and the different parts fit so closely together they are apt to be broken while trying to take them apart. I would like to find some means of softening the cement so that chipping of the porcelain would be avoided. G. B. L., Halifax, N. S.

The cement can be softened by soaking the insulator in sulphuric, nitric or other strong acid, which may, however, be diluted with water to render it safe and convenient to manipulate.

REINFORCED CONCRETE DOCKS AND WHARVES.

Kindly inform me whether or not concrete-steel has been used for the construction of docks or wharves, and where I could get information regarding plans and cost of same.

FRED T. WILLIAMS,
City Engineer, Petoskey, Mich.

Marsh's "Reinforced Concrete," ($7.00) and Buel and Hill's "Reinforced Concrete," ($5.00), recently published, give data regarding reinforced concrete wharves or quays at Southampton, England and Nantes, France, but with very little detail. There does not seem to be any other literature on this subject, though there are numerous descriptions of plain concrete piers, docks and breakwaters.

BEST CEMENT FOR SIDEWALK WORK.

Can you inform me what three makes of American Portland cement have proven to be the best for sidewalk use?

G. H. K., Burlington, Iowa.

Scarcely any two men selected at random would make the same list. The qualities which a good sidewalk cement should have are: That they meet the specifications for a first-class Portland cement given in the "Handbook for Cement Users" ($3); that there shall be no

appreciable variations in the quality of the cement; that the color shall be uniform; that the cement shall not set too quickly, subject to modification under special conditions; that it shall "work" easily and there shall be a minimum of floating of light impurities to the surface in finishing the walk; that there shall be little if any efflorescence, caused by free lime or other soluble ingredients. Nearly all of the most prominent brands of American Portland cement approximate these requirements. Color must be chosen to suit the taste.

No two persons agree exactly on these questions and some discussion of them by our correspondents will be of interest.

EFFECT OF STEAM ON CONCRETE.

Our people here have been using wood for the purpose of constructing steam boxes which are used to steam wood bolts in before they are put under the knife and cut into staves. This proves to be very expensive and they think that they can construct these boxes out of concrete for less money than they can of wood, providing they will stand the steam which they will be subjected to for about twelve hours out of twenty-four. The only question in it is will the concrete stand live steam without affecting it in any way. C. & J., Hickville, O.

The effect of omitting a comma is seen in the question from this correspondent printed in the January number, page 31, on this subject. As to the effect of steam upon concrete it may be said that concrete of the ordinary materials would not be affected chemically. The box would be expanded and contracted by the variations in temperature and if it is not so designed as to permit the necessary changes in form its walls might crack. It should not be difficult to make provision for this, and probably some kind of steel reinforcement, such as expanded metal or wire cloth would aid in preserving the integrity of the walls. Care must be taken also to make the concrete as impervious as possible so that the loss of steam through the walls will be slight.

PATENTS ON HOLLOW WALLS.

You ask for information relative to the making of a two-piece hollow concrete wall, as to whether laying an eight-inch wall and a wall built of half blocks would infringe existing patents. We beg to say it would. For the information of your correspondents we have to advise that we control patents as follows:

No. 704,606, issued July 15, 1902.
No. 733,928, issued July 14, 1903.
No. 742,094, issued Oct. 20, 1903.
No. 743,391, issued Nov. 3, 1903.
No. 749,796, issued Jan. 19, 1904.
No. 767,338, issued Aug. 16, 1904.
No. 767,413, issued Aug. 16, 1904.
No. 767,414, issued Aug. 16, 1904.
No. 769,655, issued Sept. 6, 1904.
No. 769,656, issued Sept. 6, 1904.
No. 771,816, issued Oct. 11, 1904.
No. 773,647, issued Nov. 1, 1904.
No. 782,441, issued Feb. 14, 1905.

Several of which patents the construction mentioned would infringe. We also have nine other applications for patents pending, the claims upon several of which have been allowed. All infringements will be prosecuted by us.

AMERICAN HYDRAULIC STONE CO.,
J. A. Ferguson, president, Denver, Colo.

The inquiry referred to was printed on page 221 of the March number of Municipal Engineering. The above list of patents will enable any one interested to consult the Patent Office Gazette and reports and form his own judgment of the points and methods of construction which they cover.

STAMPS FOR LETTERING CEMENT WORK.

Can you tell me where I can get letters made of type metal set on wood blocks one letter to each block for stamping anything one wants on cement. I wish to buy alphabet of one-inch letters for such use. J. C. B., Mayfield, Ky.

Can our readers refer us to anyone supplying what is asked for? Some search has failed to find exactly what is wanted.

CONCRETE BOWLING ALLEY.

Will you kindly give me specifications and directions for laying cement bowling alleys? Please note especially the gutters at side, and top finish coat.
J. M., Long Island City, N. Y.

The same surface would be required as for cement walks, several specifications for which have been given in Municipal Engineering. Several specifications will also be found in the "Handbook for Cement Users," ($3.00) the third edition of which is now in press. The editor would not recommend cement for the wearing surface of a bowling alley, believing that it would wear the balls unduly and give trouble from cracking under the shock of their fall. Division into blocks would probably be necessary to prevent temper-

ature cracks, and the joints would be a source of complaint. The gutters might perhaps be of concrete, with a smooth troweled surface and joints at regular intervals, and the foundation of the alley proper also, using wood for the surface of the alley proper only. Has concrete been tried for this purpose by any one?

MOISTURE ON CONCRETE BLOCK WALLS.

Users of building blocks are having different experiences with regard to dampness. When the interior air is kept reasonably dry the results are quite satisfactory, but when kept well saturated with moisture there is more or less trouble with dampness, especially so during very cold weather. The dampness is not especially noticeable but is sufficient to cause leather goods placed near the wall to mould.

Now, we want to make these walls that have been already put up as nearly damp proof as possible, and would greatly appreciate your advice in the matter. Of course there are a number of commercial preparations and the old alum and soap application, but what in practical experience has been found most economical and satisfactory is the question. Not having experience ourselves are not caring to place too much confidence in the claims of manufacturing chemists, we are asking you for information, believing that you are conversant with the results of the best methods and are able to furnish us information that can be relied upon.

C. P. C., ——, Iowa.

The description given indicates that the dampness on the walls is not due to moisture coming through the block from outside, but is rather due to the condensation of the moisture in the warm, damp air of the room upon the colder surface of the wall. This can be prevented only by keeping the surface of the wall warm enough, so that the moisture will not condense upon it under ordinary conditions. It would of course be impossible to do this in a room filled with steam, but it can be done for the ordinary room under ordinary conditions.

Stone walls give rise to this same complaint, since they, like concrete, conduct the heat of the room away so rapidly that they condense the moisture in the air whenever it reaches a certain amount, the location of the "dew point" being directly determined by the temperature of the air in contact with the wall and the amount of moisture in the air. Brick walls are affected in the same way to a less degree, brick being a poorer conductor of heat. A wooden wall may be so thin that in very cold weather there will be the same trouble. When cold rooms are first warmed up and occupied there may be a similar trouble for a time until the wall surface has been warmed.

If the wall is hollow and the air in the hollow space can be warmed, the inner part, betwen the hollow and the room, may be kept warm enough to be above the dew point with the usual amount of moisture in the air of the room. The ordinary furring and plastering of a room answers the purpose, the plaster being porous enough to let the warm air through into the space behind in sufficient quantity to keep the plaster above the dew point.

Another method is to paint or plaster the wall with a non-conductor of heat which will be absorbed by the pores of the surface so that it will adhere. Asphalt paints have been recommended for this use and it is claimed that paint or plaster can be applied directly to the asphalted surface. If the theory is correct the saphalt forms a non-conducting layer between the cold stone and the plaster or paint which is in contact with the air in the room, and thus prevents lowering the temperature of the air in contact therewith, the slight thickness of plaster or paint being quickly warmed when the room is heated. If practice bears out the theory this is the easiest way to treat a wall already built.

The alum and soap process would not have much effect under the conditions as described. If moisture actually comes through the wall from outside it might be used on the outside. Other methods of waterproofing blocks were described in the March number of Municipal Engineering. They may be needed to complete the cure, but not if the facts are at all times as stated in the question. See also the new edition of the "Handbook for Cement Users" ($3), now in press.

HARDENING OF CEMENT.

Will cement continue to harden after the moisture has dried out?—I. A. Jackson, Clarksburg, W. Va.

If the moisture dries out of the concrete before the chemical action of setting is completed, the concrete is injured, at least temporarily. So far as observations have been made the increase in strength, which is probably the effect in mind, continues indefinitely. The early stages of the process are comparative

ly rapid. The later ones are extremely slow. The term "dry" is comparative and the effect of absolute lack of moisture has never been observed.

CURING OF CEMENT BLOCKS.

Will you please inform us through your valuable magazine at what age cement brick and blocks may be, to be piled outdoors without being harmed by freezing?

JORDAN LAKE SAND CO.,
Odessa, Mich.

Some block makers say 8 days under shelter is sufficient and others that the time should be 10 to 15 days. The time depends on the speed of setting of the brand of cement used, and the temperature of the shelter house. There are preparations on the market which seem to hasten the setting of cement so much that the blocks or bricks can be set outdoors or used within a day after making. The after-effect of these substances upon the blocks must also be considered Some chemicals apparently strengthen the concrete, while others weaken it and others ultimately disintegrate it. Some have discoloring matter in them also. It is necessary, therefore, in using any preparation of this sort to know what it is and whether its action is beneficial or otherwise.

THE TUBE MILL—BOOKS ON LIME.

I am very anxious to get hold of some articles or books on the tube mill and its behavior.

What is there in print on the subject of lime?

B. S., Memphis, Tenn.

The tube mill is a very simple machine but its operation is not yet fully understood, and there are great differences in the theory of its action. In the Engineering and Mining Journal for Nov. 17, 1904, will be found an illustrated article on the operation of the tube mill, translated from the German of Hermann Fischer. Photographs were taken showing the internal operations under different conditions, of amount of material and rate of revolution, and are reproduced in the illustrations. Mr. Fischer develops a theory of the operation of the mill based on these observations, which can hardly be stated except by reproducing the entire article. The speed, the rate of feeding, the size and number of balls, the proportion of material to be ground, its hardness and size of particles, the rate of discharge and position of discharge opening, the fineness required, all have their effect on the output of the mill and with so many variables what a mill will do under the control of an unknown operator can not be predicted.

The variation in capacity may be shown by the catalogue statement that a 4 by 16-foot tube mill will pulverize from 3,500 to 6,500 pounds of Portland cement clinker per hour. One 5 by 21 feet is estimated to have twice the capacity. A softer substance might be run through more rapidly and a harder one might require more time.

Books on cement which describe processes of manufacture, such as Redgraves's "Calcareous Cements," ($3.00) give some descriptions of grinding apparatus, but there seems to be no book in English going into the detail of the subject.

Gilmore's "Limes, Hydraulic Cements and Mortars" ($4), Redgrave's, above referred to; Baker's "Masonry Construction ($5), and similar books give the ordinary treatment of the subject of lime. There is in process an awakening upon this subject due to the invasions made by cement and plaster and the composition and use of lime are now subjects of close study which should soon result in some valuable improvements in manufacture and greater knowledge of methods of using limes of various compositions.

Upon these subjects the following references will be of value:

In Municipal Engineering, vol. xxvi, page 227, an article on "Clinker Grinding of Portland Cement;" in vol. xxv, page 147, one on "Preparation of Dry Materials for the Kiln;" page 227, "Preparation of Slag, Lime-Stone Mixtures;" page 405, "Preparation of Wet Materials for the Kiln," all of which have a little something upon the work of the tube mill. In vol. xxvi, uage 290, is an article on the "Cost of Building and Operating a Portland Cement Plant," which has a small amount of information about tube mills. In vol. xxvii, page 250, is an article on "Portland Cement Crushing and Grinding Machinery," which gives some details upon the ball and tube mills. With reference to the subject of lime the article on "Steam for Hardening Cement and Lime Mixtures" in this magazine, vol. xxvii, page 436, contains a list of previous articles on sand and lime brick. There is an article, "Tensile Strength of High Calcium and Magnesium Lime," in vol. xxviii, page 4.

METHOD OF MAKING SAND LIME BRICK.

A short time ago we saw in several American journals notice of a new method of manufacturing bricks from ordinary lime and sand, these two being mixed and forced into molds, the air then exhausted and water introduced, the resulting heat and expansion producing a brick as hard as granite. We have been endeavoring to secure further information with regard to this process and have been referred from one party to another. If you can give us the necessary information or address of the proper source to which to apply, we will be very much obliged, indeed.

C. B., Galt, Ont.

Can our readers give us any information regarding this system? Stoffler's "Silico-Calcareous Sandstones" ($1) gives descriptions of two or three plants using quick lime in making sand-lime brick, but the above seems to be a modification of the process there described.

"GRANITE" BRICK FIREPROOF.

A correspondent from Canada asks for information about "granite" brick. This is a term sometimes applied to sand-lime bricks, but the propriety of the term is not easy to see. There is no granite in the composition except that possibly the sand is from decomposed granite, and tests of sand-lime brick show that it stands fire far better than granite. The following extract from a letter from the Little Rock Furniture Manufacturing Co., Little Rock, Ark., gives some evidence on this point:

After we had our building constructed, I had a great many misgivings as to whether the sand-brick would stand fire, for many of the insurance men were inclined to be prejudiced on account of the brick being in what they term the experimental stage, and were afraid that it would not stand against heat and water.

At the time we built our building the brick plant here had not been completed, and they were not in a position to furnish us with brick as rapidly as we wanted them, and it was necessary to lay clay brick on the inside work, and on the back wall between the two warehouses. Part of the wall was built of the red brick entirely. Part of this wall passed through our recent fire and is now standing. The red brick was burned out, at least two or three inches. The white is intact. The same way with all of the walls, the red brick had crumbled, while the white brick was perfectly sound.

Yours truly,
E. J. BODMAN, Sec'y.

MUNICIPAL MATTERS IN COURT

Higher Courts—Elgin Municipal Light—Alton Water Works—Passaic Valley Sewerage Commission—Leaky Reservoir—Marysville Sewer Contract.

Abstracts of Decisions in the Higher Courts on Matters of Interest to Municipalities.

Prepared by R. H. Sullivan, Indianapolis, Ind.

City Council Does Not Have Sole Right of Accepting Carnegie Library—Andrew Carnegie offered the city of Shelbyville, Ky., $10,000 with which to erect a library, on condition that the city furnish a site and guarantee the sum of $1,000 per year to maintain said library. The Council accepted the conditional offer. The Kentucky Court of Appeals held that the Council exceeded its authority and must refer the offer to the citizens of Shelbyville for acceptance or rejection. Ramsey et al. vs. City of Shelbyville, 33 S. E. Rep. (Ky.)

City Liable to Contractor. Illegal Assessments—Though a contract between a city and a contractor for a public improvement provided that assessment certificates should be received in full payment without recourse on the city, and the contractor's receipt for the certificates recited that it was a receipt for all

demands, nevertheless the city was liable to the contractor for the amount of the certificates, where the assessments were illegal. Younker vs. City of Des Moines. 101 N. W. Rep. (Iowa) 1129.

Removal of Trees—It is held in Iowa that the removal of trees by a city in the prosecution of a plan for the improvement of a street does not give a cause of action to the owners of abutting property. Kemp vs. City of Des Moines. 101 N. W. Rep. (Iowa) 474.

Council's Discretion in Management of Lighting Plant—A city may conduct an electric light plant in the manner which promises the greatest benefit to it and its inhabitants and the City Council may enter into a contract to furnish electric light to persons residing near the city, but outside of its borders. City of Henderson vs. Young. 83 S. W. Rep. (Ky.) 583.

A Municipality Must Comply with Law—Where a city passes an ordinance for grading a street and it is done without ascertaining the damages, the city is liable to property owners injured thereby. Schrodt vs. City of St. Joseph. 83 S. W. Rep. (Mo. App.) 543.

Assessments Must Conform to Law—Where a sewer was not constructed as authorized by the ordinance, the assessments for the same will be cancelled at the suit of the property owners. Barton vs. Kansas City. 83 S. W. Rep. (Mo. App.) 1093.

Under St. Paul Charter Contractor May be Sued—The Minnesota statute providing that no action shall be maintained on a contractor's bond unless written notice is given to the principal and sureties within ninety days after the last item of labor or materials is performed or furnished, has no application to contractor's bonds given pursuant to the charter of the City of St. Paul. Grant et al. vs. Berrisford et al. 101 N. W. Rep. (Minn.) 940.

City Contract with Corporation Containing Councilman—A contract between a city and a corporation in which a member of the City Council is a stockholder is void and does not become legal, even though the stockholder subsequently sells his stock. Hardy vs. City of Gainesville. 48 S. E. Rep. (Ga.) 921.

Municipal Warrants Negotiable only by Legislative Act—In the absence of express legislation, municipal warrants, though negotiable in form, are not negotiable in fact, and hence are not within the protection of the rule which guards commercial paper in the hands of innocent purchasers. Morrison vs. Austin State Bank. 72 N. E. Rep. (Ill.) 1109.

A Reassessment for Betterments Constitutional—In Massachusetts the statute authorizing the reassessment of betterments for public improvements is held to be constitutional and not productive or unequal taxation. Warren vs. City of Boston. 72 N. E. Rep. (Mass.) 1022.

Elgin Municipal Lighting Situation.

The city of Elgin, Ill., and the Elgin, Aurora & Southern Traction Company have been enjoined from dismantling the municipal plant of that city. With the understanding that the company should sell the city light, ten members of the City Council voted to lease the plant to the traction company. The contract with the traction company would have been operative April 1 but for the injunction, and unless some drastic action is taken before that time the city will be in darkness, for the finance committee only appropriated enough money to run the plant until that date.

Alton Water Works to Be Sold.

The property of the Alton Waterworks company, Alton, Illinois, will be sold by Master in Chancery Walter McClellan of the United States District court at Springfield, April 18, the sale to take place at the court house at Edwardsville. According to the decision of Judge Otis Humphrey of Springfield, which was affirmed by the United States Court of Appeals at Chicago, about $800,000 in bonds issued on the property by C. H. Venner of Boston, Mass., will be rendered worthless, as the property is given over to the holders of the first and second mortgage bonds, whose claims will hardly be satisfied by the proceeds, according to the estimated value of the plant. It is thought probable that the holders of the bonds will bid in the property. In consideration of an extension of franchise, a representative of the bondholders has been communicating with the city officials with regard to making extensive improvements in the system.

Passaic Valley Sewerage Commission Act Unconstitutional.

The court of errors, at Trenton, N. J., set aside, March 6, as unconstitutional the act creating the Passaic Valley Sewerage Commission and its provisions for the

construction of a system of trunk sewers from the falls at Paterson to the meadows below Newark and thence into New York Bay. The Supreme Court decided, July 23, 1904, that the act is unconstitutional. On July 31, 1904, the case was taken to the Supreme Court and Chief Justice Gummere granted a writ of certiorari to review the action of the Passaic Valley Sewerage Commission in passing a resolution authorizing the issuance of $1,000,000 of bonds as part of the $9,000,000, the estimated cost of the proposed relief sewer, and another resolution providing for an issue at the time of $1,000,000 to begin the necessary work. The chief ground for setting aside the act was the delegation of the taxing power to a body in the selection of which the people have no voice.

Leaky Reservoir Injures Farming Land.

Suit has been filed in the Supreme Court of New Jersey against the Jersey City Water Supply Company for $5,000, by William J. Righter of Parsipanny, Morris County. The suit is in the nature of a test suit, as many farmers in the vicinity of Parsipanny claim losses and damages from the same cause, which is an allegation that the seepage and overflow from the big Boonton reservoir "back wall" have converted Mr. Righter's forty-acre farm into a lake. According to the plaintiff the leak from the big reservoir can only be remedied by its entire reconstruction. If successful in the present suit application will be made in Chancery for an injunction to restrain the defendant water company from maintaining the back wall in a leaky condition. The Boonton reservoir was completed and put to public use last year, and it supplies Jersey City, Hoboken and other Hudson County towns.

Marysville Must Pay for Sewers.

Judge McDaniel rendered a decision at Marysville, Cal., March 13, in favor of that city in the action of the City Street Improvement Company against the city of Marysville, awarding the defendant the entire amount asked for on cross complaint, $27,977 and costs. The suit grew out of the construction of the sanitary sewerage system for the city by the plaintiff company. A large number of defects were found and the city was compelled to rebuild it, the work being in progress now. The case will be appealed.

WATER PURIFICATION

Indianapolis Filter Plant.

The Sand Filtration Plant of the Indianapolis Water Works.*

By W. C. Mabee, Construction Engineer, Indianapolis Water Company.

"The purification of water consists in the removal of disease germs and other substances, which derange the human system, and also the removal of those substances which affect the appearance of water and its use in the household, as well as in the industrial arts." This can best be accomplished on a large scale, with a water having the characteristics of White River, by a system of slow sand filtration such as has been built by the Indianapolis Water Company.

Location.—The filtration plant is located on a thirty-six-acre tract of land lying north of Sixteenth-st. and south of Cairo-st., and between the canal on the east and Fall Creek on the west. The present installation occupies eight acres and is located at the north end of the tract, leaving ample space for future extensions. Plans and specifications were prepared and the plant was built by the United States Sand Filtration Company of Indianapolis and Pittsburg, under contract dated Sept. 4, 1902. The writer acted as constructing engineer for the water company.

Description of Plant.—There were con-

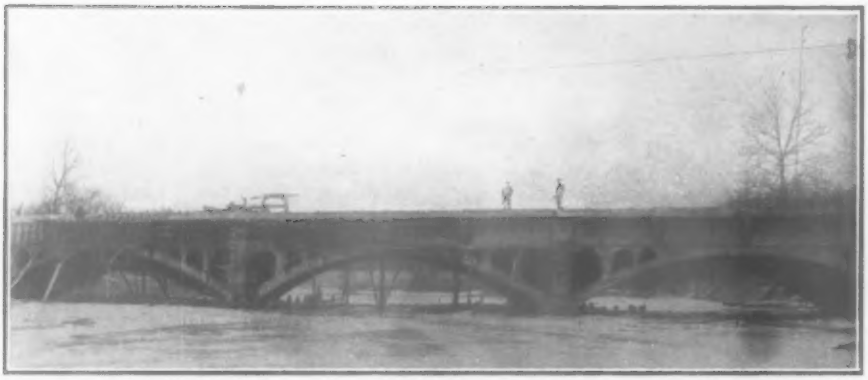
*From a paper before the Indianapolis Technical Club.

structed three open filter beds and two covered clear water basins, a laboratory building and two operating houses, together with all necessary piping and accessories. There was also built a main conduit to convey the pure water to the Riverside Pumping Station. The work was completed Dec. 16, 1904, at which time the last of the three filter beds went into service. They have been in operation during the winter, and have rendered very efficient service, judging from the quality of the filtrate. Fall Creek has been used as a source of supply, pending the construction of the aqueduct across Fall Creek. A photograph of the aqueduct accompanies this paper.

Source of Supply—The principal source of supply will be from White River, which is impounded at Broad Ripple by a dam built and maintained by the Water Company.

Sanitary Character of White River Shed.—"The drainage area of White River above the mouth of Fall Creek is in round numbers 1,700 square miles. On this area are located four incorporated towns, as follows: Muncie, with a population in 1900 of 20,492; Anderson, with 20,178 population; Noblesville, with 4,792 population, and Broad Ripple with 487 population. These towns are situated about 54, 38, 30 and 8 miles in a straight line from the pumping station respectively. By river these distances would be much greater. This area is a prosperous farming community, and contains numerous farm houses and small hamlets. It is probable that the population connected to sewers on this watershed, at this date, does not exceed twelve thousand people. While there exists upon the White River watershed the potential danger which is incident to the river water flowing through inhabited areas, it is by no means a highly sewage polluted stream in the sense in which the term is generally used in this country. The river, however, at times shows the marked influence of manufacturing waste, notably from the waste liquor of the strawboard industries. The pollution from the latter cause, is at times, sufficient to make the water unfit for use in its raw condition, and the difficulties attending the removal of this pollution are so great as to make it obvious that this strawboard waste should be kept out of the river."

From Broad Ripple the water will be conveyed to the filtration plant—a distance of about eight miles—by an open canal forty feet wide at the bottom and having slopes of 1½ to 1, and with a depth of five feet when flowing full. The canal is also used for hydraulic power purposes at the Water Company's pumping station on W. Washington-st., and serves as a sedimentation basin. Suitable head-gates are located at Broad Ripple and an intake is provided at the filter plant. Water is now taken from Fall Creek and pumped to the filter beds. For this purpose, there are located in the basement of the laboratory building two centrifugal pumps of, nominally, ten million gallons capacity each, made by the R. D. Wood Company of Philadelphia. Steam is supplied from two Cahall boilers of 150 H. P. each, located in the rear of the laboratory building. A 24-inch cast iron suction main connects these pumps to Fall Creek, where there is located a submerged intake crib built of 8x8 oak timbers bolted together and covered with a rack of 2x12



I. CONCRETE-STEEL AQUEDUCT OVER FALL CREEK. INDIANAPOLIS WATER COMPANY.

oak timbers with ⅝-inch spaces between each. The crib is 20 feet wide and 28 feet long, and lies in the channel of the creek. A low loose rock dam was built just down stream from this crib to impound the waters of Fall Creek slightly, and to reduce the lift on the pumps.

Above the filter intake the drainage area of Fall Creek is approximately 360 square miles. In this area there are no large towns having sewerage systems, but it is quite thickly populated for a farming community.

Passing through the pumps, the water enters the preliminary strainer, and then

II. PRELIMINARY FILTRATION APPARATUS. INDIANAPOLIS WATER COMPANY.

on to the final sand filter. These strainers, or separators, were invented and patented by Mr. F. A. W. Davis, president of the water company. There are six of these in the present installation. Each unit is made of a cast iron cylinder five feet in diameter, set vertically, having an inlet below and an outlet above a cylindrical cage containing the straining material, which is held in place by screens in the bottom and on top of the cage. The top screen is compressed on the sponge layer by a screw press revolving about a stem, to which is attached an eyebolt for removing the cage. A washout drain is connected to the bottom of the outer shell and discharges into Fall Creek through a ten-inch drain considerably below the intake. The top crib of the shell is capped by a cast iron, flanged cover, bolted down securely. To remove these cages, for the purpose of cleaning the sponge and coke, there is provided a traveling crane, built by the Central Machine Works of this city. The cages are cleaned at least once in thirty days, depending upon the turbidity of the creek. The second photograph shows this apparatus.

The intake from the canal is now in course of construction, the details of which are shown on the plans. There are four arched openings, two feet eight inches wide and four feet high, having cast iron guides fastened in the concrete on either side, with the faces machined, to insure a perfect contact fit with the gates. The gates are made of cypress three inches thick, bound on three edges with cast iron and faced with brass, to prevent the gates from rusting fast to the guides. The gates are raised and lowered by racks and pinions operated by worm gears. Immediately in front of these gates are placed an iron rack and removable brass screens.

After passing through the sluiceways, the water is strained through a layer of sponges two feet thick five feet high and forty-five and a half feet long, placed in removable cages surrounding the in-

take pipe, and then passes along a 48-inch cast iron pipe to the second set of strainers heretofore mentioned, and thence, by gravity, to the filter beds, the elevation of the water on the filters being eight feet lower than the surface of the water in the canal. All the racks, screens, gates and sponge cages will be housed in a brick building, 28x21x9 feet, having a track supported from the roof trusses for a suitable carrier to raise the sponge cages for the purpose of cleaning.

After leaving the second set of sponge strainers, the water is conveyed to the

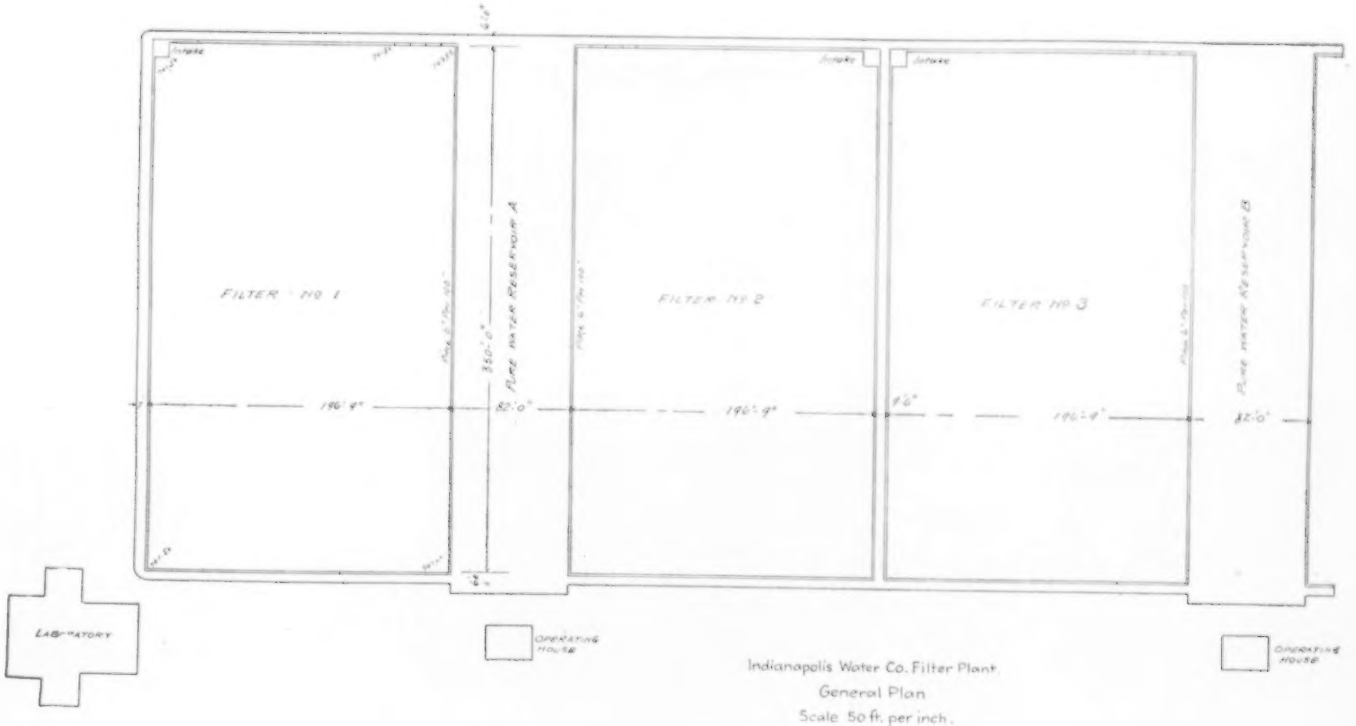
III. CONCRETE-STEEL CONDUIT. INDIANAPOLIS WATER WORKS.

filter beds by a concrete conduit, 42 inches high and 42 inches wide at its base, reinforced by expanded metal, and is six inches thick at the crown. A photograph of a cross section of this conduit is shown in the third photograph. This supply pipe runs the entire length of the three beds, supplying each bed through a 20-inch pipe, 12 feet long. At the end of each of these intake pipes is a balanced disc valve, operated automatically by a copper float carrying the two horizontal discs, and having a vertical range of three inches. The copper float is surrounded by a stilling box of galvanized iron, perforated in the bottom. The water is discharged into the inlet chambers 10 feet square, and passes through two arched openings, six feet wide, to the filter proper.

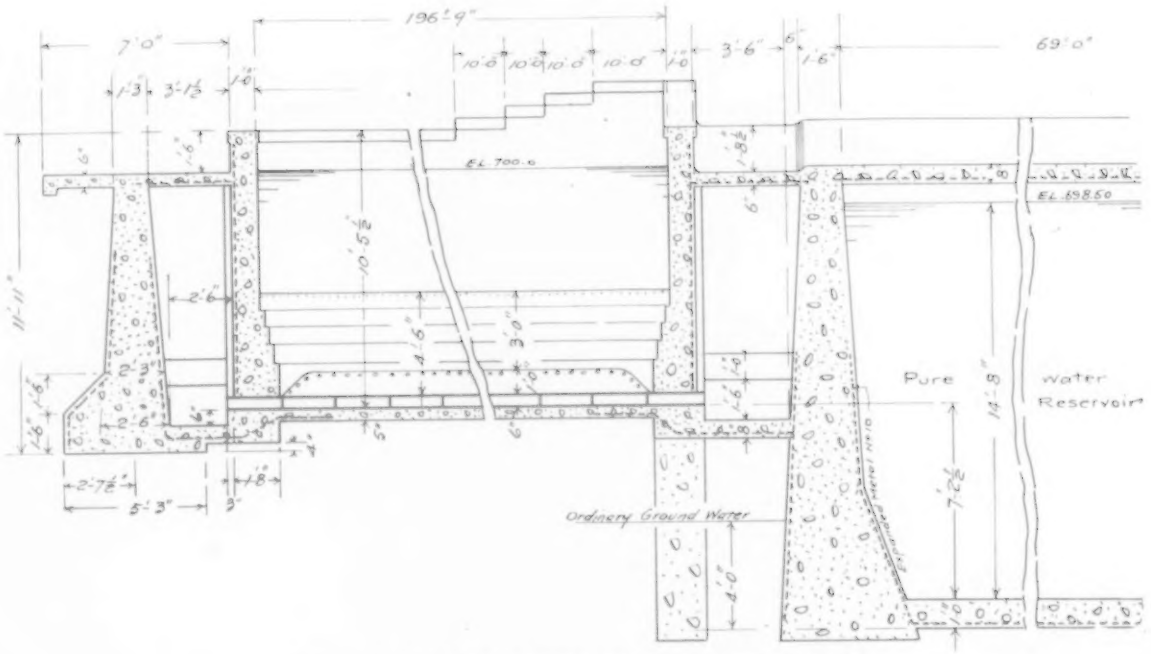
Ground was broken on the 10th day of September, 1902, and the work was finished in December, 1904. The excavation extended to gravel through four feet of sandy soil, which made a very excellent foundation.

Each of the three filter beds is 350 feet long and 200 feet wide, containing about 1.6 acres of filtering surface, or a total area of filtering surface of 4.8 acres. The fourth and fifth plates show a plan of the filter beds and a section of a filter and part of a clear water basin.

After the bottom of the excavation was carefully leveled off a one-inch layer of clayey soil was spread evenly over the entire surface and rolled with a heavy roller, the object being to prepare a bottom that would prevent the moisture from escaping from concrete while it was setting up. On the clay bottom was placed five inches of concrete mixed in the proportions of one part of cement to three parts sand and four parts gravel, and put down quite wet. The concrete was laid in strips sixteen feet wide, leaving a sloping edge for the adjoining layer to adhere to. These edges were carefully mopped with a pure cement grout to insure good bond. The surface of this floor was not troweled, but was left



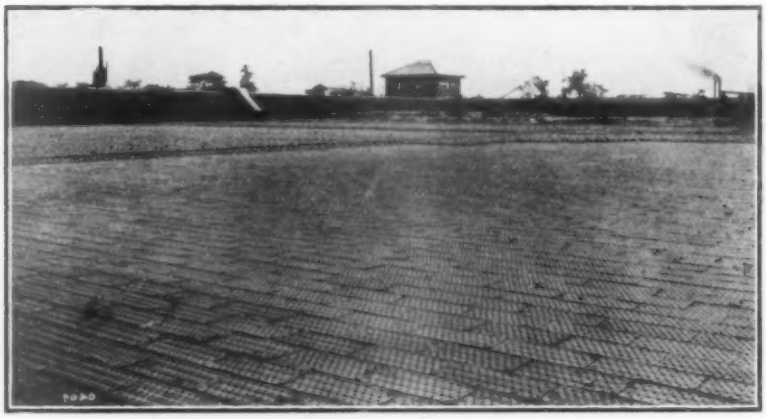
IV. PLAN OF FILTER BEDS, INDIANAPOLIS WATER WORKS.



V. FILTRATION PLANT OF INDIANAPOLIS WATER COMPANY.

Section of filter bed and part of clear water basin.

purposely rough—to receive the drain tile. The walls are built of concrete of the same proportions as the floor, but were reinforced with No. 10 expanded metal, 2½-inch mesh, the proportion of metal to concrete by volume being 1 per cent. The base was made 0.5 the height of the wall, but the section was reduced at a point about two-thirds the distance from the top to 0.2 the height of the wall, dependence being placed upon the projecting toe of the wall and the reinforcement to prevent overturning. The width of the top of the wall is one-tenth its height. The filter walls contain one cubic yard of concrete to a running foot of wall. The walls are carried eighteen inches above the high water level to prevent waves overtopping the same. Around the outer edges of the beds and at the level of water on the bed, is laid a sidewalk of concrete five feet wide and six inches deep.



VI. FILTER BED OF INDIANAPOLIS WATER COMPANY.
Showing perforated tile bottom and layers of gravel and sand.

On the concrete floors of the filter beds are placed rectangular vitrified drain tile, perforated on top with one-half-inch circular holes about three and one-half inches apart. Each tile is two feet long and one foot wide and six inches deep, and has two intermediate partitions. The drains cover the entire bottom; they are imbedded in cement mortar and are laid lengthwise across the narrow way of the bed and serve to convey pure water to the collecting gallery, located at one side of the bed. This collection gallery is formed by building a narrow concrete wall, 3-16 inch away from the main wall, and on top of the tile drain. A concrete strut twelve inches square, located near the base, separates the two walls. The space thus left is covered by a concrete slab, having four manholes for access and ventilation. In this covered collecting gallery is placed a four-inch pressure pipe for flushing any accumulation in the under drain tile to the opposite of the bed, where there is located a similar covered space termed the cleaning gallery. This gallery is connected to the main drain leading to Fall Creek; thus provision is made to waste the effluent, should it become necessary, and also to carry off the wash water. Manholes for ventilation are also placed in this gallery, thereby causing a current of air to pass under and through the entire filter when it is out of service for cleaning.

The inner side of the filter walls, below the sand line, as shown in the section, Plate V, are stepped off in five steps 1⅝ inches wide, to offer an obstruction to the raw water passing down along the wall into the drains.

On the tile is placed 12 inches of carefully graded and washed gravel, laid in four layers, each 3 inches thick, ranging in size from coarse gravel in the bottom layer to buckshot gravel in the upper layer, arranged so as to prevent sand from passing into the under drains. Over the gravel and against the walls, down to the tile is placed 3 feet of sand, carefully washed and screened and leveled to a true surface. The sixth plate is a photograph showing the perforated tile and the

gravel and sand layers partly in place. At the west end of the collecting galleries and diagonally opposite the inlet chambers are located the outlet or effluent pipes, 24 inches in diameter, on which lines are placed the venturi meters, furnished by the Builders' Iron Foundry of Providence, R. I. Each meter is equipped with a chart recording device operated by floats in float chambers, connected to the throat of the meter by small pressure pipes. The device registers the rate of discharge to the tenth part of a million gallons and records upon a revolving circular chart the rate per day of flow in million gallons. The chart makes a complete revolution once in twenty-four hours.

After being measured, the water from each bed enters one chamber of the operating house, so constructed that four beds can be operated from this one central point. In each chamber is placed a telescopic weir, made of seamless brass tubing 20 inches in diameter, flared and sharpened to a knife edge at the top, operating in a cast iron cylinder against a brass bushing packed with one strand of braided flax packing. This telescopic weir is carried by a copper float in the form of an angular ring and is regulated from the floor above by a hand wheel on an indicator stand, through which rises a square brass stem, fastened to the weir and threaded through a spider on the float. By raising or depressing the float, the depth of water flowing over the circular weir is decreased or increased at will. Once set to any required depth, the operation is automatic and the rate of flow constant, until it is desired to increase or diminish the rate. This apparatus, together with all the other valves, were furnished by the Eddy Valve Company of Waterford, N. Y.

It is generally understood that filters, to maintain their maximum efficiency, should run at practically a constant rate; hence, the introduction of the telescopic weir.

From these chambers the water is either discharged directly into the main pure water gravity conduit, or is discharged into the covered clear water basins, for storage. In the operating houses are installed floats and targets which indicate the loss of head due to the friction in the sand layer and enable the operator to tell the condition of each bed at a glance. Each clear water basin is sixty-nine feet wide, 350 feet long and fifteen feet deep, and contains 2,500,000 gallons, making a combined storage capacity of 5,000,000 gallons. The bottoms are seven feet below the filter bed bottoms and were prepared in a similar manner, except that the thickness of the floor is twelve inches and is reinforced with expanded metal to resist the upward pressure of ground water.

The roofs of the clear water basins are pitched six inches per 100 feet of length and crowned transversely three inches at the center to shed the rainfall to the sides and carry it rapidly to the sewer.

A sewer drain is provided twenty inches in diameter to take off all surface drainage, wash water and wasted effluent.

Concrete piers 15 inches by 18 inches and resting on bases four feet six inches square and two feet deep, support the concrete roof, which is of a barrel arch construction. There are ninety-six supports spaced twelve feet six inches apart across the narrow way of the basin and fourteen feet in the other direction.

Concrete beams two feet deep and one foot wide, reinforced with four one-inch steel round rods laid one inch above the bottom of the beam, are run transversely across the basin every fourteen feet. Built into the beam is the arched floor, having a rise of four inches in the center and a crown thickness of eight inches and reinforced with expanded metal, No. 10 gauge, two and one- half inch mesh.

The piers, beams and roof were laid monolithic, except that the roof was divided into sections separating over each girder to provide for contraction cracks.

The walls of the clear water basin are also reinforced with expanded metal. All concrete work was done by the Expanded Metal Fire Proofing Company of Chicago, acting as subcontractors. Altogether 15,000 cubic yards of concrete were placed. All walls were constructed as a monolith, taking care of the contraction cracks after they occurred by driving oakum into a groove cut out at each crack. Wires were used to hold the forms in place. The vaulting of the clear water basins has stood a test of 400 pounds to the square foot, uniformly distributed. Each clear water basin is provided with a thirty-inch vitrified supply pipe, which conveys the water from the operating house to the remote end of the basin. The outlet valve is located at the opposite end of the basin, which causes the water in the basin to be kept in constant circulation when the valve is opened. Just back of the thirty-inch outlet valve is located a thirty-inch overflow riser, the elevation of which is eighteen inches below the full water line of the filter bed.

The pure water is then conveyed through the main conduit to the distributing well at the Riverside Pumping Station, from which point it can be switched to any or all the pumping engines as required, including the W. Washington-st. Pumping Station.

This main conduit is constructed of concrete, reinforced with expanded metal, and has a crown thickness of 6 inches, is 50 inches in its greatest dimension and has a fall of 8 feet and 6 inches in its length of 5,600 feet, and is laid on a uniform slope. Its area is slightly in excess of a 48-inch pipe. It has a maximum discharging capacity of 50 million gallons in 24 hours.

The buildings are built in pressed brick laid up in Harvard bond, and trimmed with Bedford oolitic limestone. They have steel-trussed roofs with slate covering and make a very beautiful appearance. All structural iron was furnished by the Noelke-Richards Company of this city.

The laboratory equipment is up to date in every particular.

In connection with the boiler room there has been erected a brick-lined steel stack 60 inches clear diameter and 125 feet high, resting on a solid concrete foundation 14 feet square and 20 feet deep, and built by the Sinker-Davis Company of this city.

CEMENT AND CONCRETE

Cement Posts—Concrete Blocks Fireproof.

Cement Posts.*

By C. L. Catherman, Elkhart, Ind.

A demand exists for posts that are strong, convenient and durable. They must also be inexpensive. In the greater part of our country, timber suitable for posts is fast disappearing. The quality of the wood posts is becoming inferior and the prices are advancing. The life of an ordinary white cedar post, which is the most common in use, varies from five to nine years. It is safe to say that in forty years at least five sets of new posts are required. Although prices of cedar posts vary in different localities yet we may safely say that an average of 16 cents a piece is a reasonable price. The posts would cost at this rate five times 16 or 80 cents. The labor involved in resetting posts and fastening fences during this time will amount to no less than 20 cents, making the total cost no less than $1.00. Many have tried iron and steel posts, but the constant action of the atmospheric agencies, especially at the soil line, soon works destruction to the posts unless they are of large size, which increases the cost too much.

In view of the fact that wood is becoming scarce and high in price and that it soon rots, and that iron and steel are also unsatisfactory, substitutes have been tried, but it was not until Portland cement began to be used extensively that a practicable substitute was found at a reasonable cost.

I think it unnecessary at this time to say much about the strength of concrete, its fire-resisting qualities, its increasing hardness and strength as it increases with age, its resistance to and the disintegrating effects of frost. I am aware that the men of this convention are so familiar with facts concerning concrete work that the mere statement is accepted without any doubts that a cement post well made and of good material is sufficiently strong when properly reinforced that it cannot break under any ordinary conditions, that fire will not injure it, that it will increase in hardness with age, and that frost will not injure it.

There are, however, several important phases of the cement post question which should be considered.

Experience and observation have sufficiently demonstrated the necessity of a reinforcing device. Good materials and carefully prepared are essential, but the

*A paper before the convention of Iowa Cement Users.

vital factor of the cement post is its proper reinforcing.

The earlier form of cement post consisted of a wood post embedded in a concrete base, but this proved unsatisfactory for two reasons: It did not prevent the posts from rotting, gave it no more strength, and with the expansion and contraction of the wood, due to different degrees of moisture, either caused the concrete to crack or the wood core to become loose in the base. This led to a later form, in which wood was completely embedded in the concrete, and was intended to serve as a reinforcing device and as a preservation of the wood, but this plan failed for two reasons. There is but little bond between wood and concrete, and therefore the wood fails in a purpose to reinforce, and the swelling of the wood cracks the concrete, or it shrinks in the post and becomes loose.

A step in advance was made when metallic reinforcements were used. Several different forms of metallic reinforcements have been used and patented, but there are a few precautions to use even with the metallic reinforcements. It is better to use the metal distributed in the corners than to use the same amount in a solid rod through the center. The reinforcing devices should have rough surfaces or means to prevent their slipping when the post is under strain. Barbed wire is an ideal reinforcement.

The ratio of cement and sand depends on the quality of the material, varying from one to three to one to five. Good, sharp, clean sand and gravel should be used. Gravel passing through a half-inch mesh is satisfactory, but enough fine material should be used to fill all voids. I prefer sand and gravel to crushed rock, although I have had but little experience with the crushed rock. A neater post can be made by using the "dry" mix, but it requires more care and time than the "wet" mix. I used the "wet" mix almost entirely and prefer it, for the staples can be more easily embedded and the tamping can be done quickly and easily and without interfering with the reinforcing wires. And let me add right here that wood molds are proving the best "post machine" that has yet been offered for the manufacture of cement posts. I use the wood molds in sets of five resting on one pallet of wood or cement covered with a coating of shellac. I refer to the molds for the line posts. Posts of special design can perhaps better be made in single molds. One advantage especially of the wood molds is their low cost. A man can equip an extensive plant with but little capital. The molds can be used for a number of years if proper care of them is taken. It is a good thing to give the molds a coating of shellac. In using the "dry" mix it would be better to make the posts in a single mold, for the mold is removed as soon as the post is made. Using the "wet" mix posts should remain in molds at least twenty-four hours.

Right here has been the chief cause for failures which some men have had in trying to manufacture cement posts. It must be understood by all that a post cannot be made like a block. The block can be made by a machine, rest on a pallet and be carried off. The post cannot, or should not, be carried away on a pallet immediately after it is made. The post is long and heavy and its weight will cause the pallet to sag in the middle and if carried when green the post will surely crack. The cracks may not be visible at the time, but they will be in evidence when the post is cured.

Quite a number of failures have resulted in experimenting with cement posts. There are several reasons: In some instances not enough cement was used. It is false economy to try to rob the post of cement. I am of the opinion that no less than a one to five ratio of cement should be used, although a strong post can be made from a less proportion, but such a post should not be used or submitted to strain less than a year after it is made.

Another reason for failures is that posts have been used too soon after they were made. It is a well known fact that concrete does not attain its maximum strength for several years.

There are instances where posts were used ten days after they were made. They will stand as line posts provided they receive no jar, but a post should be thoroughly cured before used and this will take at least a month. Six months is better and a year's curing will yield a post practically unbreakable.

It is my opinion that where the post was properly made no less than seventy-five per cent of the failures have resulted because they were moved before the posts had set and cured. Posts must not be moved from their pallet until they have set and hardened. Until I had considerable experience in making posts I found a number of them cracked when I wanted to use them. The re-inforcing

with wires of course prevented the posts from bending over or breaking off, but I could not for some time ascertain why the posts were cracked. But I soon discovered the cause. It was due to the fact that I had moved the post before it had cured, and that my moving it, although I was ever so careful, had caused small hair cracks to be made which at that time were invisible, yet were there in fact and were sure to show later. If a post machine ever proves a success it must be built in such a way that the machine shall be moved away from the post rather than the post shall be moved from the machine.

But the manufacture of cement posts is no longer an experiment. When properly made, properly re-inforced and well cured before being handled they are very satisfactory. I know of cement posts in use in a fence for about twelve years, and the posts today are in as good condition as when first put in the ground. I know of cement anchor posts used for a wind-mill that have been in use for eighteen years, and another instance for twenty years, and they are in perfect condition today.

One problem to solve was how to fasten a fence to a cement post. One of the first methods was to wrap wire around the post. This answers the purpose, but requires considerable time to fasten the fence and is not neat in appearance. Another device was to put holes through the post. There are a few objections to make to this plan. It is not adapted to a woven wire fence nor to a barbed wire fence. It also requires considerable time to make the holes and also weakens the post. Cleats of wood embedded in the post to which the fence might be nailed have proved unsatisfactory on account of the swelling and drying out of the wood. A better plan is to bolt cleats of wood to the post and nail to them. The devices that have given the best satisfaction are suitable staples which can be embedded in the post where desired, and a lock or retaining rod inserted through the staples holding the fence wires between this retaining rod and the post. The special feature of this device is its convenience. A fence can quickly be attached and any time it is desired to remove the fence from the post, the rods can quickly be pulled out, loosening the fence from the posts. One advantage of a cement post, besides its indestructibility, is its neat and tidy appearance. It is also especially adapted for ornamental purposes, since it can be molded into any form or size. Besides fence posts, they can be used for mile, hitching, mail box, telephone, park, dooryard, cemetery and especially vineyard posts.

An additional feature of most of the cement posts now manufactured is a device for protection against lightning. This is a very practicable and beneficial device and should be used on posts in wire fences.

The superiority of cement posts over wood, iron or steel posts is their indestructibility and consequent saving of cost. It is a matter of economy to use a cement post. I stated before that to maintain a wood post for forty years, including cost of labor to set it, is no less than $1.00. How much will a cement post cost for the same period of time? A line post 7 ft. long should contain approximately the following amount of materials:

From 12½ to 16 lbs. Portland cement, at least 2 lbs. of metallic reinforcement and a little over ½ cubic ft. of sand and gravel. Cement at $1.50 will cost from 5 to 6 cents. Wire at 2¾c, 5½c. Sand and gravel at 50c per cubic yard, a very little over 1c. You may estimate 12½c to 13c for material. Two men can make 100 posts per day, hence the cost for labor will be from 3c to 4c, making the post cost complete from 15c to 17c. They can be made and sold at a reasonable profit for 25c, but they are cheaper to buy at 50c than wood posts at the prevailing prices. The cement post will last longer than 40 years, during which time it costs to maintain a wood post at least $1.00.

Cement posts can be made on the farm. The farmer can make them for himself at a very low cost, for he can make them at times when farm work is not urging. He can in this way have his men employed to good advantage and have the posts ready for use when he needs them. It is a good way to keep the boys on the farm to let them make posts to sell. They are interested in such matters and are pleased to have a plant of their own and engage in a profitable business.

In many localities the heaving of posts by frost is a perplexing difficulty. I make my posts gradually tapering from the top to the base. This feature, combined with the weight, prevents in a large measure the heaving, the posts being securely anchored on account of their shape.

Another advantage is that there are no disadvantages. Every feature of a ce-

ment post can be placed on the credit side. Briefly, a cement post costs no more than a good wood post; is indestructible, is adapted for all kinds of purposes; is strong; is a money saver; is a post that when attached to a good fence will keep stock in or out of a field; is fireproof and especially adapted for railroads; is neat and tidy; is not affected by heat, cold, moisture, frost or rain; is a sure means of increasing value to the property where used; is the post for concrete workers to manufacture and secure good profits because it is a ready seller; is the post for the future as well as the present.

Concrete Blocks Fireproof.

The following letter under date of March 28, from Lewis McNutt, a dealer in clay products, cements, etc., in Brazil, Ind., is self-explanatory:

Concrete blocks have certainly achieved a reputation in this locality. The little town of Carbon, of about 1,300 population, was almost wiped off of the map by fire last Saturday night. Brick business rooms and brick buildings were leveled to the ground by the flames. There was one building that was made of concrete blocks, and it alone withstood the fire, notwithstanding all the other buildings in every direction around it were leveled to the ground. It was certainly remarkable how it stood the test.

ROADS AND PAVEMENTS

Oil on Asphalt Streets—Traction on Asphalt and Brick—Iowa Roads.

Oil Asphalts on New York Streets.

The following from a report of Nelson P. Lewis, Chief Engineer of the Board of Estimate and Apportionment of New York City, gives the results of his investigation into the use of asphalts made from petroleum in laying asphalt streets in Greater New York.

So far as the use of oil asphalts in this city is concerned, it has for some time been believed that some such material has been used. In the borough of Brooklyn, where the highway work was in my charge until March, 1902, I became satisfied that, while the earlier pavements laid under the name of Alcatraz asphalt were made from a hard, natural bitumen, some of those more recently furnished by the Brooklyn Alcatraz Asphalt Company were made of an oil asphalt.

The contractors, with apparent sincerity, said that they used the material which was furnished them by the producers and that they were not sure what they were using. It must be admitted that the earlier pavements of that company, in which they were known to have used a hard, natural asphalt, were inferior to those laid subsequently. The extent to which oil asphalts have been used in this city is probably known only to those who furnished the material. The most experienced engineers in charge of paving will, I think, frankly admit that they do not know.

Since the amendment of the Manhattan specifications, I have received a statement made by Mr. A. S. Sampson, who prescribed the paving mixtures for the Brooklyn Alcatraz Asphalt Company, in which he says:

"I find by my records all the pavements laid by the Brooklyn Alcatraz Asphalt Company since July 25, 1898, up to Jan. 1, 1902, were made of the distillate oil asphalt. All of the pavements laid by the Atlantic Alcatraz Asphalt Company in Jersey City in the year 1899, also many streets laid in New York City by them during that year were made of California distillate oil asphalt; also all pavements laid by this company in New York and Jersey City during the year 1900, up to October of the same year, were made of times be sacrificed.

"All pavements laid by the New York Asphalt Construction Company since September, 1902, up to January 1, 1904, were also made of the distillate oil asphalt."

I believe Mr. Sampson to be a man whose statement can be relied upon. Since receiving this information I have examined a large number of the pavements in the Borough of Manhattan which, according to Mr. Sampson's statement, were made of oil asphalt. Some of them had been badly mutilated by plumbers' cuts and openings made for various purposes, but I found them to be in uniformly good condition and to compare favorably with those made from other asphalts

Mr. A. W. Dow, the expert in charge of asphalt pavements in the District of Columbia, in speaking of oil asphalt, says: "I myself am perfectly satisfied that some of these asphalts made from

distilling oils are satisfactory in every way for paving. The great trouble with this class of asphalts is that they are manufactured by about every little oil refinery in California. There are but two that I know of who know anything about what is required for paving, and if the others happen to strike it it is more good fortune than good management."

It appears to have been conclusively shown that very satisfactory pavements can be made from oil asphalts, and that such pavements have been laid in this city during the last six years with entire satisfaction. The oldest of these pavements are in the Borough of Brooklyn, and many of those in the Borough of Manhattan are in streets subject to considerable traffic, even though they are situated "above Fifty-ninth-st." I believe that, as a rule, the hard, natural asphalts are safer,, because in their treatment the production of a bituminous cement for paving is the main object, while in the case of oils there are other products, to obtain which the quality of the residue used for paving may sometimes be sacrificed."

Although every possible precaution should be taken to prevent the use of unstable materials and asphalt which may be simply a residue after the distillation of lighter oils, without regard to its adaptability of street paving purposes, the wisdom of the exclusion of material known to have given satisfactory results may be questioned. The recommendation that this should be done was, so far as I was concerned, made without an appreciation of the extent to which oil asphalt has already been used.

To specify the qualities of an oil asphalt which will make a durable and acceptable pavement, and those which will render such a result doubtful, and to define, in a specification for asphalt paving, requirements which will establish a satisfactory standard, is exceedingly difficult, if not impossible. The Committee on Road Materials of the American Society for Testing Materials now has the question under consideration, and the sub-committee on the testing of asphalt for paving hopes to be able to formulate some tests which will accomplish this result. One member of that committee, who is a recognized authority on asphalt paving, has told me that he has about come to the conclusion that the safest way to describe what material is acceptable is to name the brands produced by those who know the requiremen's of a good paving cement and have demonstrated their ability to produce such material of a uniform quality.

In my opinion, there is little hope of preparing a specification for asphalt paving which will not be the subject of attack and dispute. We are dealing with a group of materials which are not sharply defined, either physically or chemically. New deposits and new processes are continually being discovered, and if any of them are excluded, favoritism is alleged. An asphalt controversy has been in progress since bituminous pavements have been laid, and it is more than probable that it will continue indefinitely.

Good Roads in Iowa.

The following paragraphs from Prof. A. Marston's report on Iowa road work to the Iowa Engineering Society have some special interest:

A General Survey of the Good Roads Problem in Iowa—A few of the general facts bearing on the good roads problem in Iowa which have been developed in the work of the highway commission may be of interest. There are approximately 100,000 miles of country roads in our State. So far as our study has gone, we estimate that about 25 per cent or 25.000 miles of these roads ought to be classed as main traveled roads, which should be, as rapidly as feasible, made hard roads, thoroughly reliable at all seasons and during all weather conditions. With this 25 per cent of the roads thus improved, no farmer would be much further than two miles from an improved road running north and south and another running east and west, and, of course, the great majority of the population would be much closer to such improved roads. Only about 1,000 of these 25.000 miles have already been gravelled or macadamized.

Traffic on Iowa Highways—In investigating the traffic over our country roads, house to house canvasses have been made in a few typical townships located in different parts of the State, blanks being filled out for each farm showing the amount of hauling over the roads and the cost of the same, and the amount of other traffic over the roads. In these townships we find on the average that, on a basis of $2.50 per day for man and team, the cost of heavy hauling was about 40 cents per acre per annum, and the cost per ton-mile about 24 cents. Of course, estimates based on these few townships of the total traffic of the State are not reliable, but as no other data are available for such estimates, we may say that if the averages for these townships held true for the entire State the heavy traffic over the country roads of Iowa would amount to about 55,000,000 ton-miles per annum, and the other travel to about 350,000,000 miles per annum.

Realizing that estimates based on the limited data at hand are not reliable, the State Highway Commission has secured the insertion in the census questions for the census which Iowa is conducting in 1905 of an agricultural road schedule.

Road Materials and Methods for Iowa—The macadamized roads of the East have cost from $5,000 to $10,000 or more per mile. If the average be estimated at $8,000, the corresponding treatment of the 25,000 miles of main traveled roads in this State would call for an expenditure of at least

$200,000,000, and it is certain that the actual cost would be higher because we do not have close at hand in our State the necessary road materials. Conditions in Iowa are very different from those in the eastern States where State aid laws have been made use of for the construction of expensive systems of macadamized roads. For example, in Massachusetts the Chairman of the State Highway Commission informed the writer that 67 per cent of the population is concentrated in cities of over 12,000 population. In Iowa, on the other hand, not more than 15 per cent live in such cities. With 2,805,000 population, Massachusetts has only about 20,000 miles of country road, while Iowa, with only 2,232,000 population, has about 100,000 miles. Obviously much more expensive methods can be used to improve the roads of Massachusetts than would be found possible at present in our own State. We must adopt, for the present, much less expensive methods of construction in this State as a rule.

As examples of what can be done in Iowa, may be mentioned the macadamized road from Cedar Rapids to Marion which is said to have cost about $3,000 per mile, and the gravel roads of Greene and Carroll Counties in which the graveling alone cost only about $400 per mile. The grading and graveling of roads in Carroll County are said to cost about $700 per mile.

The most suitable local materials available for the improvement of our Iowa roads are broken limestone and gravel. The only objection to the limestone road, when properly made, is the fact that the stones wear rapidly so as to produce a very fine white dust which is extremely objectionable. In the East the writer found that in some States attempts were being made to maintain the macadamized roads by the use of cementing gravel as a surfacing material, and in northern Illinois some successful experience is reported in the use of gravel as a surfacing coat on a broken limestone foundation.

The trouble with the gravels of our State in many cases is that they do not naturally contain a satisfactory amount of binding material. The gravel with which such successful results have been secured in New Jersey naturally contains a very satisfactory binder. The Iowa Highway Commission is now experimenting with the artificial mixing of clay with our Iowa gravels to make them bind.

Traction Tests on Brick and Asphalt Pavements.

The following report of tests of tractive resistance of brick and asphalt pavements is taken from the report of the committee on roads and pavements of the Iowa Engineering Society, Prof. A. Marston, chairman:

In the line of relative tractive resistance on brick and asphalt pavements few tests have yet been made. On this account the results of some tests by the Civi Engineering Department of the Iowa State College may be of interest.

These tests were all made with ordinary draft wagons. For the tests at Des Moines the diameters of the wheels were 36 ins. and 52 ins., and the width of tire was 1¼ ins. For the tests at Cedar Rapids the diameters of the wheels were 42 ins. and 54 ins., and the width of the front tires was 3 ins. and that of the rear tires 3½ ins. In all tests the grade resistance was eliminated, so the results gave the tractive resistance on a level grade.

The tests at Des Moines were made by Messrs. F. McClure and A. B. Chattin, and those at Pittsburg were made by Mr. A. B. Chattin, and those at Cedar Rapids were made by Messrs. T. H. MacDonald and L. T. Gaylord, all students of the Civil Engineering Department at Ames.

These tests confirm the conclusion reached by Prof. I. O. Baker that the tractive resistance on asphalt increases rapidly as the temperature increases. They indicate that in the summer months the tractive resistance on a smooth asphalt pavement may at times be much larger than on a brick pavement.

	Tractive resistance, lbs. per ton.	Temperature. Deg. F.
Brick Pavement, Des Moines, Iowa, April 15, 1903.		
One course, sand-filled, much-worn and broken	58	35
On concrete, sand-filled, much-worn and rough	43.3	35
Same as above	37.6	35
On concrete, sand-filled, dirty, well worn	33.3	35
On concrete, nearly new, cement-filled	31.7	35
On sand, sand-filled, condition fair	29.1	35
Brick Pavement, Pittsburg, Pa. Sept, 5, 1903.		
New, sand-filled	37.2	70
Old, tar-filled, smooth, clean	28.2	75
Old, cement-filled, clean, smooth	24.4	75
Brick Pavement, Cedar Rapids, Iowa, March, 1904.		
Clean	16.0	about 60
Dirty	19.0	about 60
Asphalt Pavement, Des Moines, Iowa, April 15, 1903.		
New, quite dirty	26.7	35
New, clean, smooth	24.9	35
New, clean, smooth	23.3	35

Asphalt Pavement, Pittsburg, Pa., 1903.		
Sept. 5, old, clean, much used	29.1	66
Sept. 5, new, clean, little used	24.2	69
Sept. 25, old, dirty, little used	39.9	69
Sept. 26, old, clean, very little used, pitted	67.8	82
Nov. 6, same as above, but colder	36.5	31
Dec. 7, same as above after period of cold weather, dirty	34.4	20
Sept. 26, clean, new, very little used	55.5	82
Nov. 6, same as above but colder	31.1	30
Dec. 7, same as above after period of cold weather, fairly clean	25.5	20
Nov. 6, block asphalt, one year old, much used, worn, clean	28	38
Asphalt Pavement, Cedar Rapids, Iowa, March, 1904.		
Clean	34	about 60

MUNICIPAL AND TECHNICAL LITERATURE

Pomona Improvements—New Publications.

Improvements in Pomona, Cal.

City Engineer George P. Robinson of Pomona, Cal., reports that during the year 1904 that city expended $32,000 in curbing, sidewalks, cross walks, gutters and grading under the Vrooman law, Nearly $20,000 were expended in park improvements, including a small cement reservoir of 200,000 gallons capacity, supplied from a pumping plant, with a deep well pump driven by a gasoline engine and lifting 16 miner's inches of water 180 feet into the reservoir.

During 1905 street improvements promise to be fairly active. One mile of 8-inch sewer will be built; 2,600 square yards of asphalt paving and a mile of curbing are now under way. Petitions for about two miles of curbing, sidewalks and grading have been presented and have received favorable action by the Board of City Trustees.

New Publications.

The Hazen-Williams Hydraulic Slide Rule. $8. G. G. Ledder, Boston, Mass.

The Hazen-Williams hydraulic slide rule has been designed by Allen Hazen of New York and G. S. Williams, now of the University of Michigan, to compute the flow of water in pipes and channels.

The slide rule is applicable to the easy evolution of formulae with fractional exponents of variable quantities. The quantities in a formula for the flow of water which changes are the velocity of water; the so-called constant, which is different for each condition of surface, area of cross section, perimeter, etc.; the slope or the fall in the channel or pipe which is effective in producing velocity of flow and the diameter or hydraulic radius. One of these changeable quantities can be expressed in terms of the other three and the ordinary problems require the determination of the velocity of flow when the other quantities are fixed, and the amount of water flowing with this computed velocity and the area of cross-section.

The formula selected for the construction of this slide rule is one which represents as nearly as possible the average conditions shown in experimental research. It expresses the velocity as equal to a constant multiplied by the slope with exponent 0.54, and the hydraulic radius with an exponent 0.63 and the constant 0.001 with the negative exponent 0.04.

The fixed rule has the usual logarithmic scale, No. 1, on one limb and another, No. 4, graduated for slope in feet per 1,000 from 0.01 to 50. The movable rule slides between those two and one side has

three scales numbered, 2, 3a and 3b, the two latter being respectively graduated for hydraulic radii from 0.5 to 8 and the other for diameters from 0.3 to 120 inches.

With this rule velocities are computed thus: The given diameter or hydraulic radius is placed opposite the slope. A value of c for the particular case is taken from a table on the back of the fixed rule. Opposite this value on scale No. 2 will be found the velocity on scale No. 1.

On the opposite side of the sliding rule are scale No. 5 and scales Nos. 6a and 6b giving diameters of pipe from 2.6 to 86 inches.

With this rule quantities of flow are computed thus: The given diameter on scale 6a or 6b is brought opposite the slope on scale 4. Opposite the assumed value of c on scale 5 will be found the discharge in American gallons per twenty-four hours on scale 1.

If a pipe is more than eighty-six inches in diameter, the actual diameter may be divided by 2.4, and the actual discharge will be ten times this discharge for this computed diameter; or the divisor may be taken as 5.76 and the discharge of the corresponding diameter of pipe multiplied by 100.

Special computations may be easily made, such as determining the change in flow with a change in head or slope; the change in size of pipe for a change in slope, the discharge to remain the same; compound pipe discharges, etc.

The convenience of the rule has been tested a number of times by the writer and it is well nigh indispensable to a busy engineer when he has even a few hydraulic problems to solve quickly and accurately.

ORGANIZATIONS AND INDIVIDUALS

Iowa Cement Users—Technical Meetings—Civil Service—Personal Notes.

Iowa Cement Users' Association.

The first convention of Iowa Cement Users was held March 1 and 2 at Iowa State College, Ames, Iowa. The registration from outside the immediate neighborhood was about 150 and the enthusiasm and interest showed the need of this kind of meetings.

Prof. A. Marston called the meeting to order and R. G. Coutts of Grinnell was made chairman, with Prof. Ira A. Williams of Ames as secretary.

Most of the papers presented at the convention will be printed in this and succeeding numbers of Municipal Engineering. The full list is as follows:

"The Concrete Block Industry," by O. U. Miracle, Minneapolis, Minn.; "Curing of Cement Building Blocks," by James Wimmer, Perry, Ia.; "Ornamental Cement Work," by A. O. Tabor, Waterloo, Ia.; "Cost of Making and Prices Charged for Building Blocks, Sidewalks, Etc.," by L. L. Bingham, Estherville, Ia.; "Standard Specifications for Sidewalks," by W. D. Faus, Webster City, Ia.; "The Mixing of Materials in Concrete Work," by R. G. Coutts, Grinnell, Ia.; "Manufacture of Concrete Fence Posts," by H. A. Low, Lake City, Ia.; "Cement Posts," by C. L. Catherman, Elkhart, Ind.; "Tests of Cement Building Material," by Prof. A. Marston, Ames, Ia.; "Practical Methods of Testing Cement Outside of the Laboratory," by Ernest McCullough, Chicago, Ill.; "Cement Culverts," by T. E. McDonald, Ames, Ia.; "The Field in Iowa for the Cement Block Industry," by Prof. S. W. Beyer, Ames, Ia.

The last was a talk illustrated with stereopticon views and showed the resources of Iowa in the way of materials for cement blocks.

The permanent organization elected the following officers:

President, R. G. Coutts, Grinnell; vice-

president, L. L. Bingham, Estherville; second vice-president, George P. Carton, Oskaloosa; secretary, I. A. Williams, Ames; treasurer, T. R. Riggs, Centerville.

The committee on uniform specifications for sidewalks was named as follows: Prof. A. Marston, Ames; S. W. Coombs, Iowa City; D. P. Faus, Webster City.

Technical Meetings.

The next annual meeting of the National Electric Light Association will be held in Denver, Colo., in June, 1905.

The ninth annual convention of the League of American Municipalities will be held in Toledo, O., Aug. 23, 24 and 25. Among the subjects to be considered are Municipal Finance and Accounting; Taxation; Municipal Ownership of Street Railways and Other Utilities; The Gathering and Disposal of Garbage; Competition in Telephones; Water Filtration; Fire Protection.

At a meeting of the Engineers' Club at Philadelphia, March 4, Robert G. Dieck, superintendent of water supply and sewers in Manila, made an address on the engineering development of that city by Americans.

The Civil Engineers' Club of Cleveland, O., celebrated its twenty-fifth anniversary March 13. The club was the outgrowth of the ideas of C. H. Burgess, formerly county surveyor, Walter P. Rice, formerly assistant United States engineer, and Hosea Paul, a civil engineer.

The 249th meeting of the New York Electrical Society was held in the lecture room of the American Institute, at 19 W. Forty-fourth-st., March 15. Dr. E. F. Roeber, editor of Electrochemical and Metallurgical Industry, lectured on Recent Developments in the Electrometallurgy of Iron and Steel. George H. Guy, secy.

The Brooklyn Engineers' Club held its regular meeting March 9. A paper on "Precise Spirit Leveling; a Description of the Instruments, Methods and Results," was presented by Lewis T. Haney, with lantern slides. Joseph Strachan, secy.

Civil Service Examinations.

Examinations will be held by the United States Civil Service Commission at the usual places April 19 and 20 for positions in hydro economics and the soils work of the reclamation service of the United States Geological Survey at $1,000 to $1,500 a year.

Personal Notes.

Albert Greenlaw was elected Mayor at Eastport, Me., March 7.

George I. Leland has been re-elected city engineer at Lynn, Mass.

F. W. Dalrymple has been appointed city engineer at Bayonne, N. J.

James A. Omberg has been re-elected city engineer at Memphis, Tenn.

Robert E. Evans has been re-elected City Engineer at Haverhill, Mass.

D. H. Conklin, former mayor of Decatur, Ill., died in that city, March 10.

Robert J. Thomas has been reappointed superintendent of water works at Lowell, Mass.

Albert S. Burnham has been appointed superintendent of water works at Revere, Mass.

David N. Cook has been elected superintendent of the water department at Salem, Mass.

Perry T. W. Hale has been appointed superintendent of water works at Middletown, Conn.

Arthur W. Dean, Nashua, N. H., has been appointed State highway engineer of New Hampshire.

L. W. Rundlett has been reappointed Public Works Commissioner at St. Paul, Minn., for three years.

J. Edward Breen has been appointed city engineer at Cincinnati, O., to succeed the late H. J. Stanley.

John W. Maxey, Houston, Tex., has been appointed engineer of roads, bridges and buildings of Harris County.

W. O. Lumpkin has resigned as superintendent of the water works and electric light department at Alexandria, La.

John S. Waller has been appointed county surveyor of Terrill County, Georgia, succeeding J. S. Spear, resigned.

Emmet Smith, formerly city surveyor of Bayonne, N. J., died suddenly of heart disease, March 11, at his home in that city.

A. J. Taylor, of Florence, Mass., chief engineer of the filter plant at Burlington, Ia., died in that city of heart disease, March 2.

Arthur Grover has been appointed city engineer, superintendent of streets and superintendent of water works at Rutland, Vt.

Frederick A. C. Perrine, C. E., delivered a lecture at Purdue University March 29 on "Long Distance Transmission of Power."

George H. Rutledge has been appointed superintendent of the municipal water works and electric light plant, at Concord, N. C.

Charles A. Hague, consulting engineer, New York City, will remove his offices to 52 Broadway, Exchange Court Building, May 1, 1905.

W. B. Groves, Shreveport, La., has been appointed manager and superintendent of the municipal water and light plant at Prescott, Ariz.

William J. Chalmers has resigned as president of the Allis-Chalmers Company and W. H. Whiteside, superintendent of

the sales department, has been elected to succeed him.

Henry W. Sanderson has been appointed superintendent of water works and the electric light department at Westfield, Mass., to succeeed Dwight H. Parsons.

William Barclay Parsons, late chief engineer of the New York Subway Commission, delivered a lecture at Purdue University March 13 on "Rapid Transit in Great Cities."

Mr. Alton D. Adams, who makes a specialty of expert reports on the costs of gas and electric supply, has moved from Boston and is now located at the State Mutual Building, Worcester, Mass.

Harry W. Smith died at his home in Newark, N. J., March 15, aged fifty-two years. Mr. Smith was the inventor of an electric conduit system for railways similar to the present third-rail system.

Prof. William H. Burr has been appointed consulting engineer of the Croton Aqueduct Commission of New York Prof. Burr has practically served the commission in this capacity for two or more years.

William F. Jewell has established an office in the Cable Building, Chicago, Ill., where he will practice as chemical and consulting engineer, giving special attention to water supplies, filtration and softening plants.

George C. Warren, vice-president and general manager of Warren Brothers Company, Boston, Mass., has been appointed president of that company to fill the vacancy caused by the death of Frederick J Warren. Walter B. Warren, formerly assistant general manager, has been appointed general manager. The other officers of the company remain unchanged and are as follows: Vice-president and general manager, J. M. Head; treasurer, Albert C. Warren; secretary, Ralph L. Warren; general superintendent, Charles O. Warren.

MACHINERY AND TRADE

A Large Riehle Testing Machine for Illinois University.

Messrs. Riehle Bros.' Testing Machine Company of Philadelphia have just completed and ready for shipment to the State University at Champaign, Ill., a 600,000-lb. testing machine of the vertical screw type which is said to be the largest ever built of this description. The plans were approved by Prof. Talbot of the university. The machine itself weighs 100,000 lbs. and is intended for testing columns, beams and irregular shaped sizes of reinforced concrete, brick construction, built up trusses, etc.

The Sand Pallet for Molding Cement Posts.

Mr. J. M. Keith, of Des Moines, Ia., is a strong advocate of the virtues of the sand pallet in concrete-block making. He says the making of concrete fence posts on the sand pallet entirely avoids the tendency of posts to crack when carried from the machine or mold, of which much complaint has been made. He does not move the posts or blocks; but moves the mold away from them and lets the concrete set thoroughly before handling.

Good Patents for Block Machines.

Silas C. Sweet, patent lawyer, of Des Moines, Ia., reports that he has secured allowance of patents for J. M. Keith, of the same place, for a concrete-block mold, a concrete fence post and a process of molding concrete objects by use of sand pallets. He also successfully prosecuted the patent issued, March 21, to the Iowa Gasoline Engine Company, of Waterloo, Iowa, for an artificial stone mold. Our representative recently found Mr. Sweet preparing another application along the same line for another Iowan.

A Kentucky Rock Asphalt Macadam Roadway.

Mr. James A. Omberg, jr., city engineer of Memphis, Tenn., after seeing the peculiar action of natural Kentucky rock asphalt, conceived the idea that it might be used for making a macadam road-

way. He experimented first in a worn-out spot of brick pavement by filling the hole with this material and turning it over to regular traffic. To his surprise, after being in place about a week, it appeared like a regular sheet asphalt repair job. He then laid a distance of two blocks on one side of Forrest Park in Memphis on the macadam order, as specified below, with the result that the "Omberg" macadam today is a surprise to the several engineers who have seen it, and is apparently a lasting and satisfactory roadway at a minimum cost. This roadway was laid on Sept. 1, 1904, and after an extremely hard winter is now said to be in better condition than at any time since it was first laid.

The most reasonable specification to follow to get proper results is: Lay 6 inches of broken stone, 2½ inch ring, in place to conform to contour of finished roadway; roll this foundation thoroughly in place; on top of this foundation spread 2 inches of 1½-inch ring clean, hard limestone, loose, and on top of this 2-inch layer spread ¾ inch of ground Kentucky rock asphalt loose, distributing same uniformly with rakes, when it is ready for roller; roll same well, which will force the ground asphalt into the voids of the loose stone top, and the result will be that the stone and asphalt will interlock and become one body. After two days the asphalt will have become compact, and after a week's travel over it the road will reach its permanent condition. Should any repairs be required or low spots be found in the roadway it is easy to repair them by adding a little stone and asphalt and rolling them in place.

On account of its simplicity, cheapness and durability, this construction recommends itself to engineers building macadamized roadways in town or cities, or boulevards in parks or elsewhere. The main advantages of this rock asphalt macadam are that it produces a dustless road which will not get muddy in wet weather; it will not cut out in heavy rains on steep grades; is not slippery, and can be washed off with a hose or swept off with street sweepers without destroying the surface of the roadway. The cheapness for the results obtained is a great advantage. In constructing new macadamized roads from 20 to 25 cents per square yard is all that it will add to the original price of roadway. No machinery or heating apparatus is required to lay this roadway, except a road roller, which is required in making any kind of a good road.

The Wadsworth Stone and Paving Company, 405 Bessemer Building, Pittsburg, Pa., can give additional details regarding this method of using domestic asphalt rock.

The Fielder Cement Block Press.

Z. Fielder and Son of Hannibal, Mo., have developed a machine for making concrete blocks under pressure which is now on the market.

The machine is made of steel throughout and operates in the following manner: A track is laid with steel I-beam ties between the rails on which bases for the formation of stones are placed. Pallets for holding and removing stone are placed in these bases and molds with hinged sides which drop down to take out block. The compressing machine runs on the track and can be located quickly and accurately over each mold. The track can be extended to any length desired and as many molds employed as economy demands. One man runs the machine from mold to mold and compresses the blocks as the molds are filled. The capacity of the machine, if a sufficient number of molds is provided, is measured by the rapidity with which the operator can move the machine and apply the pressure. It is said that five men with three mold boxes can turn out 100 blocks an hour and it is estimated that this capacity can be doubled by increasing the number of mold boxes and the number of men to serve them.

The pallets are of wood and any size of block can be manufactured, the preference being for 6 by 9 by 18 inches, as it can be handled by one man.

Full information about the machine and specifications for making blocks will be furnished on request of Z. Fielder & Son, 1017 Broadway, Hannibal, Mo.

The Northwestern Cement Block Machine.

The blocks shown herewith were made on the Northwestern cement block machine, made by the Cement Products Company, of Hampton, Ia. This machine was designed by a practical builder of many years experience in wood, brick, stone and cement block construction, who knew from actual experience the many shapes and sizes of blocks neces-

sary to construct a building without cutting blocks after they are cured and on the job, thereby causing a large per cent of loss in time and material.

Strong points for this machine are its ease and rapidity of operation, reducing the cost of manufacture to a minimum. It produces a block of correct proportions that can be laid in the wall the most economically. When laid, a perfect circulation is maintained, both vertically and horizontally, resulting in a dry wall.

Cores and dividing plate are provided to make fractional blocks, and any two fractions of blocks that equal a whole block can be made at one operation. A plate is also provided to divide the block lengthwise, making two veneer or partition blocks. Circle blocks for cisterns may also be made. Adjustment can be made from any size or kind to any other kind in two minutes or less.

The regular size blocks made are 8 inches high and 20 inches long and either 8 or 10 inches wide.

Wooden pallets are used, the same pallets answering for either size block.

The machine is built at one of the best shops in Iowa. Every part is made interchangeable. It is sold at such a reasonable price that the cost can often be made on the first job, and more machines may be added as the business increases. A card to the company will bring full information

Concrete Block Factories.

We present herewith two more photographs of concrete block factories and store buildings built with blocks made on the Chicago adjustable block machine. The first one is 128 feet long, 38 feet wide and 33 feet high. The second is 130 feet long, 117 feet wide and 38 feet high. Particulars regarding these buildings can be obtained from the Cement Machinery Manufacturing Co., Burlington, Ia.

A Practical Cement Post Mold.

J. P. Plattenberger of Savanna, Ill., has been granted a letter of patent, No. 784,176, dated March 7, 1905, for mold for making artificial stone posts. These molds are so constructed that they can be changed to any size and shape for making fence posts or hitching posts. By the use of this mold a considerable number of posts may be molded at the same time. This is the second patent that has been granted to Mr. Plattenberger since May, 1904. The first patent is for artificial stone or reinforced concrete posts.

CONCRETE BLOCK BUILDING.
Blocks made on Chicago machine.

Crushing Strength of a Century Cement Block.

The following report of a partial test of the strength of a hollow concrete block made on one of the Century Cement

Machine Company's machines is made by the W. & J. Littlejohn Granite Company, who make the blocks. The test was made by Sylvester Rumsey, superintendent of the manufactory of Rumsey & Co., at Seneca Falls, N. Y.

A rock face hollow block 8 inches high, 10 inches wide and 20 inches long, made during the week of Nov. 1, 1904, since which time it has continually stood out of doors, was put under a heavy hydraulic press to test its crushing strength. Unfortunately for us, we could only get 35 per cent of the block under the ram, owing to space limit. So, in reality, only 35 per cent of the power of the block was tried. We are looking for a strength of about 11,500 pounds to the square inch before breaking. The strain was put on gradually at first and then quite rapidly increased until no less than 60,000 pounds (thirty tons) to the square inch was on the block, without the slightest sign of a check, crack or other evidence of the result of the severe strain and just as the operator started to add more pressure, a steel plate used to apply the test cracked and until we can arrange some rig that has an equal strength with the block, we shall not know what power is required to affect them. Those who witnessed the test are ready to assert that 100 tons will be required to break the blocks.

This block is now in our office and in as perfect a condition as when first made, despite the really unfair test made upon it. The block was selected at random from a pile of over 1,200.

CONCRETE BLOCK BUILDING.
Blocks made on Chicago machine.

Sand Lime Brick in Philadelphia.

The Charles Warner Company of Wilmington, Del., and Philadelphia has recently closed contracts in the city of Philadelphia for the delivery of over 5,000,000 of the new Diamond stone-brick, manufactured on the sand-lime principle, in Wilmington. These brick have met the approval of a great number of architects and builders, as well as the building departments in the cities located in that vicinity, and at the present rate of demand and sale the full year's output of the Wilmington plant, amounting to 18,000,000 brick annually, will be contracted for within a few weeks.

The Diamond Stone-Brick Company has developed a large variety of special colors and other pleasing effects in the way of spotted and rough bricks.

The following results of tests recently made by the Spackman Engineering Company of Philadelphia of brick taken by them from a pile of about half a million brick manufactured last fall, which had been subjected until Jan. 18 to the winter, standing in the open, show the strength of this kind of bricks:

Crushing Test.—Bricks laid flatwise, as

laid in the wall, three natural colored sand-lime brick, 4 by 5 inches, failed at 42,720, 80,710 and 52,640 pounds, averaging 54,360 pounds, or 2,718 pounds per square inch.

Freezing Test.—Bricks immersed forty-eight hours in distilled water, then frozen at a temperature of 5 degrees Fahrenheit for sixteen hours; then immersed in water at 70 degrees Fahrenheit for eight hours, and this repeated ten times, giving ten freezings and thawings. Natural colored sand-lime bricks: Weight of brick before test, dried at 212 degrees Fahrenheit, 13.89 pounds; weight of brick, after test, dried at 212 degrees Fahrenheit, 13.84 pounds; loss due to freezing, .05 pounds

The effect of freezing is only shown by a slight rounding of the edges.

Crushing test of bricks which are subjected to the freezing test after having been dried forty-eight hours at 212 degrees Fahrenheit, three natural colored sand-lime bricks, 8.25x4 inches, or 33 square inches, failed at 101,240, 97,550 and 100,560 pounds, average 99,759 pounds, or 3,023 pounds per square inch.

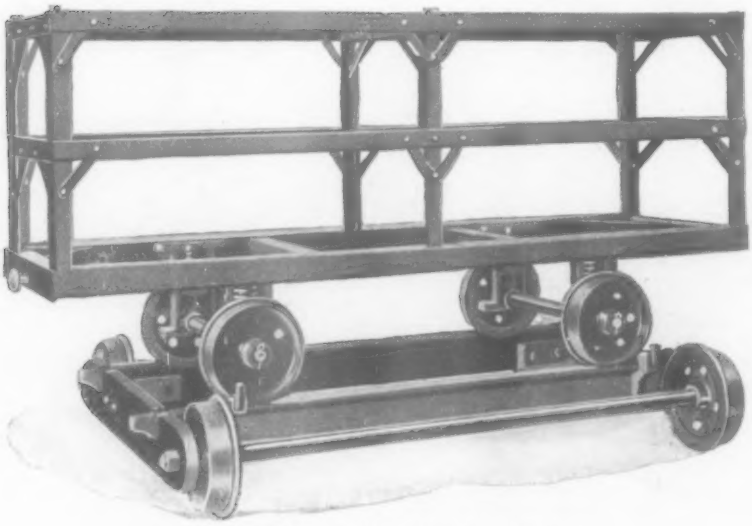
Cars for Cement Block Plants.

The line of drying and transferring cars manufactured by the Chase Foundry and Manufacturing Company of Columbus, O., is illustrated in the accompanying cuts.

This company has made a study of the requirements of concrete stone and brick manufacturers and has endeavored to build transporting equipment suitable for their requirements.

Their experience in this line of goods dates back to 1892, and insures the most modern and up-to-date equipment on the market.

Their transporting and drying car has two decks suitable for concrete stone. The decks are portable and can be removed or replaced one at a time, which makes the loading or unloading very convenient. The axles of the car are made of cold rolled steel, with roller bearing wheels. The car is carried on oil tempered coil springs, which prevents any jolting or jarring in transporting the loads, thus avoiding the danger of cracking the stones while they are green and soft.



CARS FOR CONCRETE BLOCK PLANTS.

Transportation and storage car on transfer car.

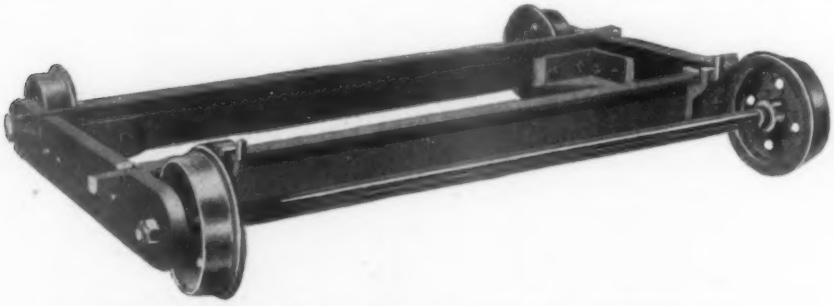
While they build any size car their customer might want, the regulation car is twenty-four inches wide by seven feet long. The buffer springs and brackets at the end of the car are placed on the inside of the angle iron ends. This is done for the purpose of reducing the space taken up by the car, which amounts to about six inches on each car. By this saving in space it will be seen that fifteen cars can be placed in the same space that fourteen cars would take up where the brackets are on the outside of the end.

The first cut represents the transport-

ing and drying car in position on the transfer car ready to be transferred to any desired track. This arrangement eliminates the necessity of switches and crossovers and in this way avoids the jolting which would naturally be caused by crossing over switches, etc.

The second cut represents the transfer car alone. It is made of the very best material, thoroughly braced and has roller bearing wheels.

The Chase Foundry and Manufacturing Company do not confine themselves entirely to the manufacture of cars for concrete stone, but include all kinds of industrial cars, trucks, etc., and are thoroughly equipped to turn out the best class of goods in their line that the market affords and at as low a price as is consistent with good material and good goods.



TRANSFER CAR OF CHASE FOUNDRY AND MANUFACTURING CO.

Catalogues will be furnished on application to the company at Columbus, O.

Some Failures of Tar Macadam Pavements.

Several street pavements have been laid in this country using broken stone and tar or mixture of tar and asphalt, some of them being devised to compete with Warren's bitulithic pavement and others having been laid independently. Some of these pavements have not been entirely successful and their failures, though partial, have been used as examples of failure of Warren's pavements. This is very unfair; first, because they are not Warren's pavements, and, second, because they are not laid in the same manner nor with the same materials as Warren's bitulithic pavement.

The nearest approach was made at Geneva, N. Y., but the board of public works, doing its own work, could not afford to rebuild its tar-macadam and asphalt plant to conform to Warren methods, used only two instead of several graded sizes of stone, used a much lighter bitumen and did not use a heavy roller in compressing the roadway. Change of officials led to neglect of this poorly constructed and unfinished street and it has not been entirely successful. It was evidently not laid by any Warren company nor according to Warren specifications and can no more be termed a Warren pavement than could a tar macadam road laid ten or fifteen years ago.

William-st. in Elmira, N. Y., is a recent example of at least a partial failure of a pavement designed to compete with bitulithic and constructed without the attention to detail and careful selection of material which good pavements require.

Paris, Ky., has had a similar experience. So have Owosso, Mich., and St. Marys, Pa. These places are named that our readers may know that the Warren Bros.' Company were in no sense connected with them and that failures in their pavements cannot be justly termed failures of the bitulithic pavements.

In contrast with these reports of failures of other bituminous pavements may be placed the following concerning Warren's bitulithic pavement from the report of the board of public works of Pawtucket, R. I., for 1904:

Based upon our experience with this pavement, which was laid on Harvey-st. and Park-place in 1901, this department recommended that the said pavement be laid on Cottage-st. from Broadway to North Bend-st. The street is narrow and occupied by car tracks. Bitulithic pavement was selected and your council passed a resolution appropriating $28,000 for laying said pavement on Cottage-st. and a contract was executed with the Warren Brothers' Company to furnish and lay the same at $2.25 per square

yard. Eleven thousand eight hundred and forty and seven-tenths square yards were laid at a cost of $26,641.58.

An appropriation of $30,000 was also passed for laying bitulithic pavement on Lonsdale-ave. from Main-st. to the city line. The contract price was the same as on Cottage-st. and 12.998 square yards of pavement were laid at a cost of $29,226.10.

We believe that the pavement has all the qualities claimed for it and in view of its favorable reception in different parts of the country, nearly all of our principal cities having laid more or less of the same, we do not hesitate to say that the city has made a profitable investment.

The Walton Granolithic Stone Machine and Block.

The mechanical construction of the Walton granolithic stone machine is the result of twenty years of practical experience in concrete work of the inventor, Mr. F. M. Walton. He set out to eliminate the objectionable features of the hollow block and to produce a machine that embodies the valuable features required.

As the most essential feature of this kind of construction is the making of a water-proof wall, and a hollow space in a block does not prevent, but merely diminishes the penetration of water, he gave to it his first attention, and the result is a two-piece wall, so constructed with vertical and horizontal air spaces, that there remain no direct points of contact between the outer and inner blocks. The rich concrete mortar, impervious to moisture, which joins the blocks, forms a barrier to water, thus securing a dry inner wall, without the expense of facing the block or of using unsatisfactory face washes, and without resorting to tamping a block with its face down, which Mr. Walton thinks is essentially wrong.

The next important feature is the supply of a sufficient variety in lengths of blocks for building purposes to obviate cutting the blocks, thus defacing the stone and giving cause for dissatisfaction. The Walton machine can be easily and quickly adjusted to lengths of 4, 8, 10, 12, 14, 16, 18, 20, 22, 24, 28 and 32 inches, 3, 4½, 6 and 9-inch heights, 30 and 45 degree angles, 10, 12 and 14 feet radius circles. Width of walls can be made from 4 inches to any width desired, giving the horizontal air space every four inches. The "L" block allows for adjusting and forming the tie at any lengths without cutting or waste of stone. Solid blocks, ornamental work and veneering stone can be made within the dimensions of the machine. Porch columns, either rock faced or plain, can be made in sizes up to 40 inches.

Another new and original feature of the machine is its reducing cores, which save material and reduce the cost of the product nearly one-fourth. These cores are used in veneering stone and on stone to be used in walls where great strength is not the essential feature. It is a well-known fact that common concrete blocks have four or five times the strength required. Tests show that a 10-inch hollow wall is equal in strength to a 13-inch solid brick wall, which allows for the using of three cores in nearly all construction work, thus furnishing excellent facilities for wiring and piping, ventilating flues and chimneys. By the use of an inner and outer block in construction of walls, the inner block which carries the load can be made of greater strength, where great carrying strength is required, or of a cheaper and commoner material, the outer block being used as a face block, with any proportion of mix or finish desired.

Imperfect blocks and dampness have necessitated in the past furring, lath and plastering of the walls. A special device which forces the mold plates positively and accurately into position, insuring clean, hard and sharp corners, making the blocks geometrically true in all their angles, allows the white coat to be applied directly to the inner surface of the stone on all walls constructed of blocks made in the Walton machines.

No time or money has ben spared to bring out in the rock-face plates the natural rock effects, and instead of a block that has the appearance of putty, with a battered face (as may be often seen), has been produced, as near as it is possible, a fac simile of the natural product, which effect sometimes deceives the practiced eye of a stone expert. This machine is a tamp machine, as Mr. Walton believes that tamping produces a block of greater density than pressure. He says that under a tamp the particles of sand being driven into the voids, the block is made of even solidity throughout and has great crushing strength, while under pressure bridging of the sand

takes place, direct pressure not allowing for the shifting of the sand, so that the voids may become filled.

One man can lay the stone without the use of the derrick or a helper.

Hollow block machines require end and offbearing plates for each different width and shape of stone made. On this machine all shapes, sizes, lengths and widths are made on the same plate, and but one shape and set is required, making a great saving in the cost of an outfit.

In the Walton one-man machine are combined many good features of the others and several new ones.

An illustrated catalogue will be sent on application to the Walton Granolithic Stone Machine Company., Eighteenth and Wabash-ave., Kansas City, Mo.

of the mistakes and evils in the manufacture of concrete blocks and in the business generally from machine to construction of building. It is lively reading and presents much food for thought. The booklet also contains information regarding the dismissal of the attachment suit brought against Mr. N. F. Palmer when at the convention of the N. A. C. U.

Those interested in good brick pavements should send for the catalogue of the Terre Haute Brick and Pipe Company, Terre Haute, Ind. It gives approved specifications for building the best brick pavements and illustrations of the methods of construction. The booklet also shows other uses for vitrified brick, such as for sewers, engine beds, foundations, bridges, piers, culverts and general building purposes.

CONCRETE BLOCK MADE BY THE CEMENT PRODUCTS COMPANY, HAMPTON, IOWA. (See page 339.)

Trade Publications.

The United States Portable Cribbing Company of Scranton, Pa., are placing on the market a new cribbing device for the purpose of saving labor and avoiding danger of caving in of ground in all kinds of excavating, such as sewers, gas and water pipe trenches, sinking of shafts, digging of wells, etc. J. H. Oliver & Co., 1414 S. Pennsylvania-square, Philadelphia, are the agents. It is described and illustrated in a neat circular.

The "Revue Industrielle" of Paris, in its issue of February 11 last, devotes a page of descriptive matter and a double page supplement of drawings to the Murray Corliss engine that was exhibited at the St. Louis fair by the Murray Iron Works Company of Burlington, Iowa.

The Noyes F. Palmer Manufacturing Company, Brooklyn, N. Y., issues a catalogue of "Dont's," which touches most

The Carson Trench Machine Company, Boston, Mass., have just issued catalogue "P," entitled "A Trench Machine Picture Book," containing thirty-six illustrations of their various styles of trench machines at work in various places. It will be sent on application.

"The Doings of Expanded Metal," is an occasional publication issued by the Associated Expanded Metal Companies, New York City, and gives the latest information about the uses of this method of concrete reinforcement.

The National Bridge Company, Indianapolis, Ind., has just issued a handsomely illustrated catalogue showing many arches constructed of reinforced concrete under its system.

The American Alsen Portland Cement Company are distributing among their customers and architects a neat advertising novelty in drawing pins with cel-

luloid covers, on which are printed the name of the company, and a picture of the works. Some are in two colors with the address of the sales office, 45 Broadway, New York City.

Trade Notes.

ASPHALT.

Peoria, Ill.—The city council decided, March 19, to appropriate $7,500 for the purchase and maintenance of an asphalt repair plant.

Oklahoma City, Ok.—The Hamilton-Ralls Asphalt Company will begin at once the development of their extensive holdings in asphalt lands in the southwestern portion of the Chickasaw nation. Machinery for working the plant will be installed. E. C. Ross, superintendent of machinery, and E. L. Penruddock, chemist, of Birmingham, Ala., have gone to the scene of operation.

BRICK.

Akron, O.—The Windsor Brick Company of this city has just patented a new curb made of shale, and matching in color and appearance with the brick used for street paving. The curb is made of the same material as paving brick and in sections of any desired length. It has in it three or four holes in which, when the curb is laid, rods of steel are imbedded in concrete to hold the joints from sagging.

Elfort, O.—The Clare plant being erected near here for the manufacture of paving brick will soon be ready for action.

Wellsville, O.—The Stratton Fire Clay Company has begun the erection of the largest sewer pipe plant in the Ohio Valley on the old De Sellem farm, a mile and a quarter above the last new plant built. The plant will be a twenty-kiln one, and will, in time, be enlarged to incorporate eighty kilns.

Toronto, Ont.—The Modern Brick and Stone Company has been incorporated by J. A. Mitchell, C. H. McFarlane, F. Sinclair and William Bullock.

San Diego, Cal.—The California Vitrified Brick and Tile Company has been incorporated and will establish a large plant here. Messrs. S. C. Lamb, S. J. Eubanks, E. P. Johnson, H. E. Eakins of Los Angeles and C. E. Anthony of San Diego are interested.

Galesburg, Ill.—The Purington Paving Brick Company, whose plant has been closed for improvements, is in full operation again.

CEMENT.

Philadelphia, Pa.—Special—The Bonneville Portland Cement Company has issued a handsome souvenir pocket tape measure 69 inches in length, and made of celluloid, which they are giving away to customers. On the front is the trade mark, a star printed in red with the name and on the back the words, "700,000 barrels furnished on filter beds, Philadelphia." The company speaks highly of the prospects and reports steadily growing sales with improved prices.

Pittsburg, Pa.—Special—About 20,000 barrels of the Dexter brand of Portland cement was used in the Pittsburg Warehouse and Transfer Company's plant, recently built here, and in which the Simplex Concrete Piling Company's system was used. In over 5,800 of the piles driven and the piers and crosswalks the Dexter cement was used.

Boston, Mass.—Special—At the new dry dock recently constructed here there were 60,000 barrels of the Dexter brand of cement used.

Sandusky, O.—The Castalia Cement Company has resumed operations after being closed several weeks for repairs.

North Sydney, N. S.—The Ruggles-Coles Engineering Company, together with C. J. Curtin, 39 Cortlandt-st., New York City, are erecting a slag cement plant here.

St. Ignace, Mich.—The remaining marl land lying just within the corporation limits of this city has been purchased by Joseph J. Works of Marquette, and a new plant will be built this spring at a cost of $200,000.

Detroit, Mich.—At a meeting of the Central Cement Association March 21, at which 17 factories, embracing Michigan, Indiana and Ohio plants, were represented, the price of Portland cement was raised from 10 to 15 cents a barrel. The advance makes the price in carload lots to Detroit jobbers about $1.21 a barrel.

Cement City, Wash.—The plans of the Washington Portland Cement Company for a plant at this town have been changed to provide for a plant with double the output first figured on, making the total 1,200 barrels daily. The officers of the company are: President, H. N. Anderson, Aberdeen, Wash.; vice-president, A. S. Austin, Aberdeen; secretary, W. W. Butler; treasurer, I. M. Anderson; general manager, E. C. Miller.

The American Alsen Portland Cement Works report very satisfactory business indications and are looking forward to a good spring trade. A call at the sales office by a representative of Municipal Engineering Magazine elicited the fact that there is a strong demand for cement and a general tendency for better prices. Said General Manager Corbett: "We are receiving inquiries from all quarters of the country, and within the last five weeks have orders for over 100,000 barrels of German Alsen. These are merely indications, and the first instalment of more to come. Altogether, we have every reason to be satisfied, and note a general advance in the leading brands."

CEMENT BLOCKS.

Terre Haute, Ind.—The B. V. Concrete Company has been incorporated by Jacob E. Voorhees, Ernest W. Voorhees, Dannie B. Bolinger and Abraham H. Voorhees.

Elm Grove, W. Va.—The cement block works of William Rumble and Edward Thompson have been put into operation.

Colton, Cal.—The Colton Artificial Stone Company is a new industry which has been put in operation.

Wyndmere, N. D.—Grant Springer has purchased a cement block machine.

Milford, Ia.—A cement building block and cement post plant is proposed here.

Park River, N. D.—Mr. Herwick has begun the manufacture of cement building blocks.

West Union, Ia.—The manufacture of cement blocks is contemplated by Jacob L. Johnson.

Reinbeck, Ia.—Robert Kydd and George Furneau will engage in the manufacture of cement blocks.

Madison, S. D.—George Beck has entered into partnership with A. J. Garner in the cement stone company.

Appleton, Minn.—Joseph Shimek of Renville, Minn., will engage in the manufacture of cement blocks here.

Clarion, Ia.—The Clarion Concrete Company has purchased a cement block machine and will soon have it in operation.

Forman, N. D.—R. B. Coy has purchased machinery and will produce cement blocks.

Amenia, N. D.—Andrew Johnson of Hillsboro and J. A. Johnson of this city have engaged in the manufacture of concrete building blocks.

Bozeman, Mont.—The Cast Stone Construction Company has been incorporated by John H. Dawes and others.

Sanborn, Minn.—The Sanborn Cement and Stone Company has purchased machinery and will begin the manufacture of blocks.

Barron, Wis.—The Barron Concrete Stone Company contemplates moving its plant to Cumberland, Wis., and will engage in the manufacture of blocks there.

Northfield, Minn.—The Northfield Stone Sidewalk Company will engage in the manufacture of cement blocks. Frank Fuller of Devil's Lake, N. D., is interested in the company now.

Tacoma, Wash.—The Tacoma Artificial Stone Company has been incorporated by J. F. Aldrich, C. A. Packard, John W. Lyons, James Lyons and M. I. Little.

Anoka, Minn.—Vrooman Bros. have purchased two sand cement sidewalk block machines and may add a machine for cement roofing tile and one for making colonial columns of cement. A cement block machine may also be added.

Willmar, Minn.—Erick Nelson and Peter Swenson have begun the manufacture of cement blocks.

Milnor, N. D.—The Milnor Lumber Company will manufacture cement building blocks this summer.

Oakes, N. D.—The manufacture of cement blocks this summer is contemplated by Ritterbush & Son and W. W. Good.

Alexandria, Minn.—J. L. Alton contemplates the manufacture of cement blocks this summer.

Tacoma, Wash.—The Puget Sound Cement and Stone Block Company has been incorporated.

Yankton, S. D.—August Goetz has secured patent rights for the manufacture of cement building blocks in this county.

Lakefield, Minn.—James Rost and A. L. Bachus have purchased a machine for the manufacture of concrete building blocks. D. L. Riley & Son of this city also contemplate the purchase of a cement block machine.

Lamberton, Minn.—Cliff Reynolds contemplates the manufacture of cement blocks.

Edinburg, N. D.—P. P. Lee will establish a cement block plant here.

Badger, Minn.—Axel Wahl contemplates the manufacture of cement blocks.

Farragut, Ia.—A company has been formed here to engage in the manufacture of concrete blocks.

New London, Minn.—A new company is proposed here for the manufacture of concrete blocks.

Pierre, S. D.—E. A. Hood has purchased a cement block outfit and will engage in the manufacture of cement blocks.

Sleepy Eye, Minn.—P. C. Hansen and C. Arvenson are engaged in the cement sidewalk business. The business of the Sleepy Eye Paving Works, conducted by the late C. P. Lungard, will be continued by Mrs. C. P. Lungard & Co.

Fairmont, Minn.—M. McCain of Brookings, S. D., and Gould & Son and W. L. Lamb, of this city, contemplate the manufacture of concrete blocks and concrete sewer tile.

Faribault, Minn.—Warren Smith has purchased a cement building block machine.

Winnebago City, Minn.—The Mankato Sidewalk Co. has reorganized and will resume the manufacture of cement blocks for sidewalks.

Brookings, S. D.—The South Dakota Cement Construction Co. has been organized here to construct sidewalks, cement blocks, etc. T. A. Muir, mgr.

Lake City, Ia.—The Electrical Concrete Post Co. will erect a plant for the manufacture of concrete blocks and posts.

Grafton, N. D.—A cement block plant will be erected here by O. E. Orvik.

Edgeley, Minn.—A cement block plant will be established here.

Keokuk, Ia.—Special.—R. H. Bowen, manager Western Brick Company, is now Western sales agent for the Ideal cement post.

Vandalia, Mich.—Special.—C. L. Catherman, inventor of the Ideal cement post, expects soon to have ready for the trade a post machine adapted to the manufacture of any cement post.

East Akron, O.—Special.—William Bixler expects to act as salesman for Central Ohio for the Ideal cement post.

Grand Forks, N. D.—Special.—George H. Ladd is arranging to operate the territory of North Dakota for the Ideal cement post.

Sedalia, Ind.—Special.—Alexander Stong has one of the finest sand and gravel pits in the State and is now preparing to man-

ufacture the Ideal cement post for the trade in Carroll County.

Constantine, Mich. — Special. — Messrs. John Blue and James A. Marsh, cashier of the Commercial State Bank, are arranging for the manufacture of the Ideal cement post in Constantine Township, St. Joe County.

Minot, N. D.—Van Tuyl & Teutsch will manufacture cement blocks.

Cloquet, Minn.—Levi Connors has purchased a machine and will manufacture concrete blocks.

Little Falls, Minn.—G. F. Clark has bought a building block machine and will engage in the manufacture of building blocks.

Waterloo, Ia.—The Waterloo Concrete Brick and Block Machine Company has been incorporated by Ralph L. Storm and others.

Beloit, Wis.—The Inman Concrete Building Block Company has been incorporated by Clarence Orion and Claude Inman.

Kaukauna, Wis.—Joseph McCarty has secured the right to manufacture concrete building blocks and will erect a plant and storehouse.

Milbank, S. D.—The Milbank Concrete Company has been organized to conduct all kinds of cement and concrete work by N. J. Bleser, Ed A. Johnson, C. E. McGowan, W. B. Saunders and Gust Swanson.

Minneapolis, Minn.—Swan Nelson has engaged in the cement sidewalk business in this city with an office at 507 New York Life building.

Albuquerque, N. M.—Work has begun on the construction of the local plant for the manufacture of building stone under the patents of the American Hydraulic Stone Company of Denver. The product of the plant will be a building stone made of gravel and Portland cement. John A. Laughlin and Charles M. Campbell, both of Trinidad, Colo., are interested.

Indianapolis, Ind.—The National Concrete Company has been incorporated by E. H. Lee, J. C. Stuckenberry and Russell T. McFall.

Jefferson City, Tenn.—G. A. Moody has purchased a block machine and is engaged in making concrete blocks for building purposes.

McArthur, O.—The McArthur Clay & Cement Block Mfg. Co. has been incorporated by F. E. Mohr, J. M. Moore, C. B. Wescoat, J. H. Best and Jack Thompson.

Litchfield, Minn.—John Engstrom will purchase machinery for the manufacture of cement brick at his cement block plant.

Birmingham, Ala.—The Cement Products Co. has been organized to manufacture cement building blocks under the American Hydraulic Stone Co. patents. F. H. Mathews is president, O. S. Heller vice-president and E. F. Hopton is secretary and treasurer.

Valparaiso, Ind.—Special.—C. W. and C. H. Dickover advise us that they have purchased a Century cement block machine and embarked in the cement block industry. They have a heated basement and have been at work all winter making blocks for summer use. The name of the firm is the Dickover Cement Building Block Company, and it deals in cement blocks and Portland cement, general work, cement sidewalks, and gravel roofing.

New Liskeard, N. Ont., Canada—Special.—Jas. Matthews advises us that he desires to communicate with architects who can supply up-to-date plans for a cement block school building.

PURCHASE OF MACHINERY.

New Liskeard, N. Ont., Canada.—Special.—James Matthews desires to communicate with architects who can supply up-to-date plans for a cement block school building.

Augusta, Ga.—Special.—Albert Markwalter, 925 Telfair-st., advises us that he is in the market for a hollow concrete block machine, and would like to receive catalogues and price lists from the different machine manufacturers.

Tipton, Ind.—Special.—H. J. Dowd advises us that he desires to purchase cement tools.

Westfield, N. Y.—Special.—John R. Fay, dealer in coal, lime, shingles, brick, sewer pipe and drain tile, etc., desires the address of parties manufacturing concrete block machines.

Waterbury, Conn.—Special.—M. D. Byrne & Son advise us that they are possible purchasers of asphalt mixers and hollow concrete block machines.

Tacoma, Wash.—Special.—Westerheide & Hall desire to receive catalogues, etc., regarding cement block machines. Also catalogues regarding reinforced concrete construction. P. O. Box 934.

PURCHASE OF MATERIALS.

Waterbury, Conn. — Special. — M. D. Byrne & Son advise us that they desire to purchase cement and asphalt.

Tipton, Ind.—Special—H. J. Dowd desires to purchase cement, paving brick and stone

MISCELLANEOUS.

Louisville, Ky. — Special. — The Turney Drier Company advises us that they have become associated with the Henry Vogt Machine Company and moved their office and works to the Henry Vogt Machine Company's plant, and elected new officers, as follows: President, Adam Vogt; vice-president, Henry Vogt; secretary and treasurer, Albert H. Vogt. They are now installing the latest improved machinery to manufacture the direct heat and steam driers, roller and filter presses, and have secured a large amount of additional capital to carry on the business.

Toronto, O.—The American Sewer Pipe Company and officials and representatives of the independent manufacturers

held a conference in New York City recently and reached an agreement which guarantees an uniform selling price for sewer pipe and clay products.

Rockford, Ill.—The highway commissioners of Rockford Township are considering the purchase of a portable stone crusher for use in building the country roads.

Bangor, Me.—Joshua P. Gould has invented a filter which can be attached to any water pipe. It consists of a cast iron box 6x8x4 inches, with a rather porous brick, cemented or packed in the center, thus dividing the box into two compartments. One side has pipe threads turned in holes at the top and bottom, and into these are fitted the ends of the service pipe over the sink. In the bottom of the other side there is fitted another pipe leading to some receptacle for holding the water.

Messrs. Swinburne & Clark, 156 Fifth-ave., New York City, are consulting engineers for the sewerage system in the Congressional office building, Washington, D. C

IMPROVEMENT AND CONTRACTING NEWS

PAVING.

Irvington, N. J.—Suit has been filed against this town by John Criqui and the municipality is required to appear in the circuit court April 1 and make answer to the charges. The suit is based on an ordinance passed by the town council March 7, providing for the widening of Clinton-ave.

CONTEMPLATED WORK.

Downers Grove, Ill.—The question of street paving is urged by the press.

Findlay, O.—The property-owners on Baldwin-ave. have petitioned for paving.

Davenport, Ia.—Brick and asphalt paving is contemplated for certain streets.

Mankato, Minn.—The city council has decided to pave the streets with brick.

Bay City, Mich.—The bd. of wks. recommended March 13 the paving of Columbus-ave.

Bloomington, Ill.—Brick paving is contemplated for W. Mulberry and N. Center-sts.

Oshkosh, Wis.—S. Main-st., from the Fox river to Ninth-st., will be paved with brick.

Sioux City, Ia.—Asphalt paving is contemplated for Fifth and Court-sts. and brick for Jones-st.

Marion, O.—A resolution was adopted March 20 for constructing a stone sidewalk on Thompson-st.

Waterloo, Iowa.—Asphalt paving is contemplated for a number of streets. P. J. Martin, mayor.

Portsmouth, Ohio.—Resolutions are pending providing for the paving of Washington, Ninth and Eleventh-sts.

Chattanooga, Tenn.—A boulevard to connect this city with the government road at Rossville is contemplated.

Greenwood, Miss.—The question of issuing $50,000 bonds for street paving purposes will be voted April 4.

West Homestead, Pa.—The question of issuing bonds for grading and paving all of the streets will be voted on.

Rock Island, Ill.—The property owners on Twenty-first and Fifteenth-sts. have petitioned for asphalt paving. Mayor McConochie.

Nashville, Tenn.—Council has appropriated $9,000 and $4,500, respectively, for paving Seventh and Sixth-aves. with bitulithic.

Rockford, Ill.—The board of local improvements will recommend macadamizing for Island-ave., S. Church, Chestnut, Horsman and Green-sts.

Superior, Wis.—Plans and specifications have been completed for paving Broadway-st., from Oakes to Clough-ave. City Enginer Thomas.

Springfield, Ill.—The property-owners on W. Grand-ave., from Wasnington to Williams boulevard, have petitioned for asphalt paving.

Auburn, N. Y.—City Engineer Ackerman has been directed to prepare plans and specifications for paving Garden, Green, Water and Clark-sts.

Manistee, Mich.—The city council passed a resolution March 8 to submit to vote the proposition of issuing bonds for public improvements.

St. Paul, Minn.—The Board of Public Works has reported favorably on the preliminary order to pave Eighth-st., from Broadway to Locust, with asphalt.

Portsmouth, O.—Resolutions have been adopted providing for the paving of Washington, Ninth and Eleventh-sts with brick, asphalt or tar macadam.

Paducah, Ky.—Bids may be opened, according to local press reports, about April 1 for reconstructing Third-st., from Ken-

tucky to Broad. L. A. Washington, cy. engr.; Henry Bailey, cy. clk.

Marysville, O.—Council has passed an ordinance providing for the paving of a number of streets with vitrified brick. J. C. Kennedy, vil. engr.

Brockton, Ill.—The village council has decided to issue $5,000 bonds for the purpose of building sidewalks, repairing roads and other improvements.

Duluth, Minn.—The property-owners on First-st., from Sixth-ave., W., to First-ave., E., desire asphalt paving. The city engineer estimates the cost of resurfacing London road from Thirty-ninth-ave. to Fifty-first-ave., W.

Meridian, Miss.—Special.—The city council has engaged Waldo G. Myers to supervise and construct the streets and sidewalks contemplated this year. Bonds on the amount of $60,000 have been sold for the proposed work.

CONTRACTS TO BE LET.

Cortland, N. Y.—Bids are asked until April 3 for macadamizing Tompkins-st. B. P. W.

Cooksville, Tenn.—Bids are asked until April 15 for paving. O. Holladay, cy. recorder.

Ft. Mott, N. J.—Bids are asked until April 14 for constructing a shell road here. Q. M.

Joliet, Ill.—Bids are asked until April 20 for asphalt paving on Richard-st. H. A. Stevens, cy. engr.

Vicksburg, Miss.—Bids are asked until April 30 for repairing road No. 39. J. D. Laughlin, chancery clk.

Findlay, O.—Bids are asked until April 8 for piking a township road with stone. E. W. Pupple, clk. East twp.

St. Joseph, Mo.—Bids are asked until April 8 for constructing a macadam road. Peter A. Jones, co. surv.

Findlay, O.—Sealed bids are asked until April 3 for constructing 4½ miles of stone pike in Delaware twp.

Sullivan, Ind.—Bids are asked until April 5 for building 20-mis. and 3,266-ft. of stone roads. Bd. co. comrs.

Paoli, Ind.—Bids are asked until April 5 for constructing roads in Stamper's Creek twp. Alvin B. Ham, co. audt.

Uhrichsville, O.—Bids are asked until April 10 for paving W. 3rd-st. with firebrick. H. O. Snyder, cy. clk.

Marion, Ind.—Bids are asked until April 4 for paving First-st. with vitrified brick. John O. Wilson, cy. clk.

Richmond, Ind.—Sealed bids are asked until April 3 for grading and graveling an alley. John F. Taggart, cy. clk.

Fort Schuyler, N. Y.—Bids are asked until April 10 for rebuilding a roadway at this post. Lieut. H. S. Miller, Q. M.

Menominee, Mich.—Bids are asked until April 10 for paving a number of streets with macadam. Fred S. Norcross, cy. clk.

Greenville, Miss.—Sealed bids are asked until April 4 for constructing 600,000-sq. yds. of granolithic sidewalk. Cy. coun.

Worthington, Ind.—Bids are asked until May 2 for constructing gravel and macadam roads in Grant twp. Wm. H. Dechard, co. audt.

Cincinnati, O.—Bids are asked until April 21 for improving a portion of Section-ave., in Sycamore twp. E. L. Lewis, co. audt.

Bedford, Ind.—Bids are asked until April 3 for constructing 6-mis. of gravel or macadamized roads. Walter G. Owens, co. audt.

Minneapolis, Minn.—Bids are asked until April 14 for furnishing 40,000-sq. yds. of creosoted blocks. Andrew Rinker, cy. engr.

Rockville, Ind.—Sealed bids are asked until April 6 for constructing certain gravel roads. T. A. Garrard, chm. co. comrs.

Bowling Green, O.—Sealed bids are asked until April 3 for grading, draining and macadamizing certain roads. B. C. Harding, co. audt.

Vernon, Ind.—Bids are asked until April 3 for constructing over a mile of pike road in Spencer twp. Phineas B. Ewan, chm. co. comrs.

Michigan City, Ind.—Bids are asked until April 3 for about 23,000-sq. yds of brick paving with cement curb. H. M. Miles, cy, engr.

Moberly, Mo.—Bids are asked until April 3 for grading N. Fourth-st. from Coates to Franklin, and paving with brick. John F. Curry, cy. clk.

New Orleans, La.—Sealed bids are asked until April 3 for paving Prytania-st., from Clio to Philip, with asphalt. Chas. R. Kennedy, comptroller.

Peru, Ind.—Sealed bids are asked until April 4 for constructing gravel and macadamized roads in Beech Creek Township. Wm. H. Deckard, county auditor.

Columbus, Ind.—Sealed bids are asked until April 3 for constructing 2½ miles of gravel road in Sandcreek Township. Jesse Day, chairman county commissioners.

Dayton, Wash.—Bids are asked until April 3 for constructing a cut-off road about 2½ miles long, with probably one-half mile of rock work. County commissioners.

Cincinnati, Ohio.—Sealed bids are asked until April 10 for paving E. Twelfth-st., from Spring-st. to Reading, with asphalt. Geo. F. Holmes, clerk B. P. S.

Lafayette, Ind.—Bids are asked until April 10 for improving a portion of Schuyler-ave., Fifteenth, Twenty-first and Tenth-sts. E. H. Andress, jr., city clerk.

New Orleans, La.—Sealed bids are asked until April 3 for paving Dryades-st., from Howard-ave. to St. Andrew-st., with asphalt. Charles R. Kennedy, comptroller.

Ogden, Utah.—Sealed bids are asked until April 8 for building and repairing all concrete walks that may be ordered during the year. A. F. Parker, city engineer.

Gettysburg, Pa.—Bids are asked until April 20 for grading and piking avenue on battlefield 1,794 feet in length. John P. Nicholson, chm. National Park Comm.

Perrysburg, O.—Bids are asked until April 17 for grading, draining, curbing,

and macadamizing Front-st., from Hickory to west boundary. T. M. Franey, vil. clk.

White Plains, N. Y.—Bids are asked until April 3 for grading, curbing, flagging and constructing Telford gutters on Kensico-ave. J. Henry Carpenter, vil. engr.

Amsterdam, N. Y.—Bids are asked until April 4 for 6,600 sq. yds. of fire-clay paving blocks on concrete foundation on Market and Bridge-sts. F. E. Crane, cy. engr.

Washington, D. C.—Sealed bids are asked until April 13 for furnishing 10,000 barrels of Portland cement. Maj. H. J. Gallagher, U. S. army purchasing agent Isthmian Canal Comn.

Montgomery, Ala. — Sealed bids are asked until April 3 for paving sidewalks with Schillinger or hexagon blocks on Virginia and Jefferson Davis-aves. R. S. Williams, cy. treas.

Shreveport, La.—Bids are asked until April 18 for repairing and putting in good condition the pavement on Texas-ave., from Jordan-st. to the Kansas City Southern railway crossing. C. G. Rives, compt.

Janesville, Wis.—Sealed bids are asked until April 14 for 2,133-sq. yds. of brick paving on W. Milwaukee-st., 3,640-sq. yds. on E. Milwaukee-st. and 4,636-sq. yds. on S. Main-st. C. V. Kerch, cy engr.

Salt Lake City, Utah—Bids are asked until April 10 for laying all cement sidewalks, including the following: Grading 10,000-cu. yds.; cement walks, 4-ins. thick, 200,000-sq. ft.; 6-ins. thick, 6,000-sq. ft. E. A. Wall, chmn. B. P. W.; Geo. W. Riter, cy. engr.

Long Island City, Ind.—Bids are asked until April 3 for regulating, grading, curbing and repaving with asphalt, as follows: 22,700-sq. yds. asphalt, including binder course; 3,500-cu. yds. concrete; 6,000-lin. ft. new bluestone curb, furnished and set, and granite block pavement. Jos. Cassidy, prest. boro Queens.

La Crosse, Wis.—Sealed bids are asked until April 18 for 1,000-cu. yds. of grading and 3,910-sq. yds. macadamizing on West-ave., from Green Bay-st. to Mormon Coulee road; 5,230 cu. yds. grading, 11,048-sq. yds. macadam, 4,860-sq. ft. concrete driveway, and 6,928-lin. ft. combination cement curb and gutter on Jackson-st., from 3rd-st. to West-ave. H. J. Beckwith, chmn. B. P. W.

Pittsburg, Pa.—Bids are asked until 10 a. m., April 5, for grading and paving with asphalt and curbing parts of Alger, Bryant, Collier, Lyric, Mt. Vernon, Murtland and Winterburn-sts., Atlantic-ave., Darlington road and Bellman, Elmore, Formosa, Kingston and Vista alleys. For paving with asphalt Pocussett-st., from Murray-ave. to Schenley Park. Grading, paving and curbing with block stone, Belthoover-ave. and Brushton-ave., Cabinet-ave., Mathilda and Perry-sts. Grading, paving and curbing and laying block stone sidewalks, Franks-town and Virgin-aves. Paving and curbing with block stone, Duff-st. and Hazelton-ave. Repaving with block stone, Marion, Seventh, Thirteenth-sts. William B. Hays, mayor.

CONTRACTS AWARDED.

Lake Charles, La.—The contract for constructing twenty-four blocks of cement sidewalks was awarded to J. George Fredericks.

Cambridge, O.—The contract for paving N. Seventh-st. was awarded to the South Zanesville Brick Company for $12,-146.92.

Tacoma, Wash.—Stoll & Jones secured the contract for grading and building cement sidewalks in District No. 246, for $29,637.

Atlantic City, N. J.—The Cleveland Trinidad Paving Company was awarded the contract for paving Atlantic-ave. for $216,000.

Rensselaer, Ind.—The contract for constructing macadam road was awarded, March 15, to H. H. Stewart & Son of Kokomo, Ind., for $14,641.

Elizabeth, N. J.—The contract for paving Third-ave., between Spencer and Centre-sts., was awarded to T. Foster Callahan for $16,078.43.

Augusta, Ga.—W. F. Bone was awarded the contract for curbing in this city during 1905 at 33¾ cents a foot for straight curbing, 34 cents for circular curbing.

Portland, Ind.—The contract for constructing the Alex Rayn stone road in Bearcreek Township was awarded, March 15, to Calvin Miller of Decatur, for $7,534.

Moline, Ill.—The contract for paving Market-st. with brick was awarded, March 20, to the Tri-City Construction Company for $2,240 and for Seventh-st. for $5,980.

Philadelphia, Pa.—The contract for paving about 20 miles of streets with asphalt was awarded March 14, to the Barber Asphalt Paving Co., at $1.55 a sq. yd.

San Francisco, Cal.—The contract for repairing the bituminous streets bounded by Larkin, Eddy and Bay-sts. and Grant-ave. was awarded to Flinn & Tracy, for $3,600.

Indianapolis, Ind.—The contract for constructing the Fall Creek boulevard has been awarded to the Moore-Mansfield Construction Co. of this city for $67,950.

Ashland, Ky.—The contract for about 2¾ miles of brick paving was awarded to John Bradley of the Nashville Roofing and Paving Co. of Nashville, Tenn., for $131,270.

Winnipeg, Man.—The contract for furnishing 1,000 to 1,500 tons of asphalt for paving purposes was awarded to the United States and Venezuela Co., 1 Broadway, N. Y. City, at $26.15 per ton.

St. Joseph, Mo.—The Peerless Artificial Stone Co. was awarded the contract for constructing articificial stone sidewalks.

Brooklyn, N. Y.—The Barber Asphalt Paving Company secured eighteen contracts March 9 for asphalt paving on a concrete foundation at $1.39 a sq. yd. This is the lowest price known in the history

of this city for asphalt paving on concrete base.

Little Rock, Ark.—The contract for macadamizing and grading the roads in the new residence district beyond Pulaski Heights was awarded to F. B. Stewart for $10,938, and for sidewalks and gutters to C. N. Feubel, for $9,200.

Racine, Wis.—The contract for paving Villa-st. with brick was awarded to the La Crosse Stone Company of La Crosse at $1.45½ a sq. yd. The contract for paving Douglas-ave. with vitrified brick was awarded to John O. Jones at $1.42 a sq. yd. and 34 cts. for concrete curbing.

Ft. Wayne, Ind.—Bids were submitted March 24 for constructing 3 mis. of pavement. On each contract the asphalt company underbid the brick contractors from 6 to 8 cents. The asphalt bids averaged $1.72 a sq. yd., the lowest, it is said, that has been submitted for asphalt in the State.

Toledo, O.—The contract for repaving Jefferson-ave., from Summit to Ontario, with 4-in. kreodone creosoted wood block was awarded to Russell & Jennison March 14 for $24,165.50. The contract for paving Walbridge-ave., from Langdon to Baden-sts., with Canton brick, was awarded to J. C. Carland for $6,795.880.

Louisville, Ky.—The contract for constructing vitrified block paving on St. Xavier-st. and Ormsby-ave. was awarded to George W. Gosnell, and on Caldwell-st. to Lee R. Figg. Bids were opened March 10 for eight blocks of asphalt paving. The only bids submitted were by the American Standard Asphalt Company and the Barber Asphalt Paving Company. The former company secured the contract for Fifth-st. from Hill to Bloom, and the latter company the contract for paving Twenty-eighth and Twenty-sixth-sts. The contract price was $1.86 and $1.88 a sq. yd.

Kalamazoo, Mich.—New bids were submitted March 6 for paving Lowell and Rose-sts. Bids were received Feb. 13 for this work. In the bids received March 6 the Lake Erie Asphalt Block Company bid on a wider range of paving than in February, and their bid was also on 3-in. block on 4-in. concrete base, and 6 cents lower than the one filed in February. The Cleveland Trinidad Paving Company made the same bid that they did in February, but bid in addition on asphalt block paving. The Barber Asphalt Paving Company submitted new bids on sheet asphalt pavement that were several points lower, according to press reports, than in the bids filed in February.

SEWERS.

Greensburg, Ind.—A sewerage system is proposed.

Beloit, Wis.—This city contemplates expending between $6,000 and $7,000 on sewer construction next summer. City Engineer Caldwell.

Sheldon, Ia.—Plans for a sewerage system have been filed. G. T. Wallman, cy. clk.

Girard, O.—This town has voted to construct a sewerage disposal plant.

Youngstown, O.—Resolutions have been passed for contructing sewers.

East Lake, Ala.—Council contemplates constructing a sewerage system.

Millville, Pa.—The plans for the proposed sewers provide for 25,570-ft. of sewers.

South Omaha, Neb.—The question of constructing sewers will be voted on April 4.

Saginaw, Mich.—An engineer will probably be engaged to improve the drainage system.

Madison, N. J.—The sewerage com. recommends the establishment of septic tanks and filter beds.

Birmingham, Ala.—The citizens of West End, a suburb, voted to issue $15,000 bonds to build a sewerage system.

Springfield, O.—The estimated cost of a sewer on Yellow Spring-st. is $8,336. W. H. Sieverling, cy. engr

Haddonfield, N. J.—The construction of sewers in the annexed district is contemplated. Allen Clymer, boro. clk.

Thief River Falls, Minn.—This city voted to issue $28,000 bonds for constructing a sewerage and waterworks system.

Amherst, Va.—Plans for a system of sewers and a sewage disposal plant for Sweet Briar Institute will be prepared

Spencer, N. C.—The question of issuing $70,000 bonds for constructing a sewerage system will be voted on April 18.

South Bend, Ind.—A. J. Hammond, city engineer, estimates the cost of a trunk sewer along Bowman Creek, at about $25,000.

Sayre, Pa.—The borough council decided, March 11, to engage an engineer to make plans and estimates for a sewerage system.

Cumberland, Ind.—The citizens have filed a petition with the county commissioners, asking that a sewerage system be constructed.

Wilton, N. H. — This town has voted to construct a house sewerage system. Isaac S. Whiting, Starr B. Center, Chas. E. Weeks, water comrs.

Asbury Park, N. J.—The State Sewerage Comn. has approved plans for a new septic tank sewage disposal plant to be constructed at a cost of $40,000.

St. Johnville, N. Y.—This city will expend $500 for employing a competent engineer to make a preliminary survey and estimates for constructing a sewerage system.

Newton, N. J.—Special.—This city desires proposals from engineers for furnishing plans, specifications, etc., for a sewerage system and disposal works. C. J. Majiry, secy. bd. trade.

San Francisco, Cal.—Plans and specifications have been approved for sewers in Mission and Amazon-sts. The construction of sewers in a large number of other streets has also been ordered.

CONTRACTS TO BE LET.

Toledo, O.—Bids are asked until April 4 for building seven sewers.

Crookston, Minn.—Bids are asked until April 6 for constructing the Roome Tynsid ditch.

St. Joseph, Mo.—Bids are asked until April 5 for constructing concrete and brick sewers B.

Cincinnati, O. — Bids are asked until April 10 for building several sewers. George F. Holmes, cy. clk.

Richmond, Ind.—Bids are asked until April 3 for building a sewer in an alley. John F. Taggart, cy. clk.

Fairmont, Minn.—Bids are asked until April 4 for constructing ditch No. 1. H. P. Edwards, co. audt.

Menominee, Mich.—Bids are asked until April 10 for building several sewers. Fred S. Norcoss, cy. clk.

Olean, N. Y.—Bids are asked until April 7 for building a sewer on N. Tenth-st. E. E. Allen, cy. engr.

Plainfield, Wis.—Bids are asked until May 10 for excavating 53,745 mis. of ditch. D. H. Pratt, secy.

Flint, Mich.—Bids are asked until April 4 for building 1,800-ft. of sewers in Harriett-st. Cy. Engr. Hall.

Puyallup, Wash.—Bids are asked until April 15 for constructing sewers in Dist. A. Robt. Wilson, cy. clk.

Oklahoma City, Okla.—Bids are asked until April 8 for constructing the Mulliken Ditch. C. O. Boe, chmn. bd. supvrs.

Portage le Prairie, Wis.—Bids are asked until April 12 for constructing a sewerage system. F. A. Whitaker, secy-treas.

Ft Leavenworth, Kas.—Sealed bids are asked until April 3 for installing a sewage lift here. Maj. D. E. McCarthy, Q. M.

Grinnell, Ia.—Sealed bids are asked until April 3 for constructing about 300 feet extension of sewers. J. F. Wilson, cy. clk.

Scottville, Mich.—Bids are asked until April 10 for building 2,100 feet of sewers, with manhole and catch basins. W. C. Freedy, vil. clk.

Franklin, Ind.—Bids are asked until April 15 for constructing a sewerage system. Otis B. Sellers, cy. engr., Arthur R. Owens, cy. clk.

New Orleans, La.—Sealed bids are asked until April 18 for constructing 65 miles of sewers and appurtenances. F. S. Shields, secy. sewerage and water bd.

Long Island City, L. I.—Bids are asked until April 3 for furnishing and delivering 2,200-lin. ft. 15, 18, 24 and 30-in. vitrified salt glazed sewer pipe. Jos. Cassidy, prest. boro. Queens.

Salt Lake City, Utah—Sealed bids are asked until April 10 for constructing 60,000-ft. 8-in., 800-lin. ft. 10-in., 800-lin. ft. 12-in., 800-lin. ft. 15-in. and 4,500-ft. 18-in. pipe sewers, with 160 manholes. Geo. W. Riter, cy. engr.

Pittsburg, Pa.—Sealed bids are asked until April 5 for cost 15 and 18-in. pipe sewers in Altietan-st. and Java alley; 15-in. sewer in Darlington Rd., Eunice-st., Ellsworth-ave., Joseph, Lamora, Wickliff and Willing-st.; 51, 40, 32 and 30-in. brick and 15, 27 and 24-in. pipe sewers in Euclid-ave.; 15, 18 and 24-in. pipe sewer in Natchez-st.; 36-in. brick sewer in Virginia-ave. William B. Hays, Mayor.

CONTRACTS AWARDED.

Augusta, Ga.—Hanrahan & Co. secured the contract, March 21, for furnishing sewer pipe during 1905, for $8,072.

Des Moines, Ia.—The contract for constructing the Ingersoll Run sewer was awarded, March 16, to Wm. Horrabin, for $33,459.

Holly Springs, Miss.—The contract for constructing a sewerage system was awarded, March 7, to Gill & Co. of Chattanooga, Tenn.

St. Paul, Minn.—The contracts for constructing sewers in Summit, Lincoln and Grand-aves. and Finn-st. were awarded to F. H. Kirkland for $15,200.

Denver, Colo.—The contract for building a sewer in sub-district No. 12 was awarded, March 13, to the Denver and Pueblo Construction Co., for $4,762.

Lorain, O.—The contract for building storm sewer district No. 1 and Plainfield-ave., district No. 4, was awarded to C. T. McCracken & Co. of Cleveland, for $35,000.

Toledo, O.—The contract for constructing sewers was awarded, March 7, as follows: Columbus-st., H. P. Streicher, $88,440.50; Oakdale-ave., O'Neill & Tansey, $104,015.

WATER-WORKS.

CONTEMPLATED WORK.

Wilton, N. H.—This city voted to extend the water system to the Hillsborough Mills.

Roodhouse, Ill.—Plans and specifications being prepared for water works system.

Louisville, Ky.—Bids will be asked for erecting about 100 fire hydrants in this city.

Owassa, Mich.—This city will vote April 3 on the issue of bonds for water works extension.

Tacoma, Wash.—This city will vote April 4 on the issue of $500,000 for constructing the South Tacoma Wells water system.

Toledo, O.—City council has under consideration a slow sand filtration plant and mechanical filtration plant for this city, and bids may be asked on both systems.

The question of issuing waterworks bonds has been favorably voted on as follows: Parkston, S. D.; Vallejo, Cal.; Thief River Falls, Minn.; White Bear, Minn.; Madrid, Iowa; Fort Frances, Ont.; Rockford, Wash.; Abbeville, La.; Coalgate, I. T.; Mendon, Mich.

Columbia, S. C.—E. N. Chisholm, jr., city engineer, has completed a report on the auxiliary pumping station in which

he recommends its construction at a moderate cost.

The construction of water systems is contemplated at the following places: Mayville, Wis.; Belpre, O.; Alturas, Cal.; Buena Vista, Ga.; Grand River, Ia.; Wilton, N. C.

Marseilles, Ill.—The Consolidated Water and Light Company, which is said to be in control of the water works and electric light plants of the city, contemplates the erection of a new power house. John M. Nicholson, prest.

Portsmouth, Ohio.—The question of issuing $25,000 bonds for moving the pumping station from its present site to another point, the purchase of machinery, construction of reservoirs and filtration, etc., will be voted on April 10.

The question of issuing waterworks bonds will be voted on at the following places: San Diego, Cal., in April; Stockton ,N. J., April 11; Merna, Neb.; Bagley, Iowa; McMinnville, Ore., April 10; Harrysburg, Ohio, April 22.

CONTRACTS TO BE LET.

Elyria, O.—Bids are asked until April 11 for a pumping engine. B. P. S.

Portage la Prairie, Man. — Bids are asked until April 12 for constructing a water works system.

Prescott, Ariz. — Bids are asked until April 3 for furnishing a pump and boiler. E. B. Moden, cy. clk.

Ellisville, Miss.—Bids are asked until April 4 for constructing water works. William M. Hardee, cy. clk.

Poplarville, Miss.—Bids are asked until April 4 for drilling an eight-inch well. D. F. Archer, Mayor.

Canton, O.—Bids are asked until April 3 for constructing a pumping station. Charles A. Sellers, clk. B. P. S.

Clarkesville, Tenn.—Bids are asked until April 3 for furnishing a pump. Z. Dean, chmn. water com.

New Albany, Miss.—Bids will be received until April 5 (change of date) for constructing water works.

Waverly, Kas. — Bids are asked until April 3 for erecting a steel tower and tank. W. W. Williams, cy. clk.

Lumberton, Miss.—Bids are asked until April 4 for drilling or boring an 8-in. artesian well. H. A. Camp, mayor.

Osborne, Kas.—Bids are asked until April 10 for furnishing 700 feet of 8-in. c. i. pipe. L. K. Green, chmn. w. w. com.

Winnipeg, Man.—Bids are asked until April 10 for furnishing 1,750 tons of water pipe and specials of various sizes. C. J. Brown, cy. clk.

Chicago, Ill.—Bids are asked until April 3 for furnishing four boilers, with stokers and appurtenances. F. W. Blocki, comr. pub. wks.

Augusta, Me.—Bids are asked until April 10 for laying a cast iron pipe line 8½ mis. long, with appurtenances, from Caleton Pond to distributing reservoir. W. B. Getchell, engr.

Boston, Mass.—Bids are asked until April 6 for constructing a submarine pipe line from Nut Island to Peddocks Island, Mass., for a 6-in. water main on Peddocks Island and a post water system at Ft. Andrews. Major John E. Baxter, Q. M.

Salt Lake City, Utah.—Sealed bids are asked until April 10 for laying all water mains that may be ordered during 1905, involving the following: Excavating and back filling, 5,000 cu. yds.; c. i. pipe, 12,000 lin. ft.; 800 lin. ft. 8-in. pipe. Geo. W. Riter, cy. engr.

New Orleans, La.—Sealed bids are asked until April 18 for furnishing water pipe and appurtenances and pumping machinery. F. S. Shields, secy. sewerage and water bd. Bids are also asked until May 11 for connecting certain water pipe recently laid at 5 points with the Chestnut-st. main.

St. Johns, N. B.—Bids are asked until April 12 for constructing a water-works construction, to be let in four contracts, and consisting of a woodstave pipe line, a 39-in. reinforced concrete aqueduct, a 48-in. concrete aqueduct and a masonry dam on Mispec River. Walter W. White, Mayor.

CONTRACTS AWARDED.

Charlotte, N. C.—The R. D. Cole Mfg. Co., Newman, secured the contract for erecting a new stand pipe for $16,000.

Iowa Falls, Iowa—The contract for constructing a pumping palt was awarded March 6 to Fremont Turner of Des Moines, for $8,000.

Waterman, Ill.—The contract for a compressed air water system was awarded to the National Const. Co., South Bend, Ind., for $4,547.

Orange, Cal.—The contract for a water works system was awarded to the S. J. Smith Machinery Co. of Los Angeles for $10,223.10.

Lorain, O.—The contract for constructing a settling basin at the water works pumping sta. was awarded March 11 to the Barry Construction Co. for $12,400. The basin will be constructed of concrete.

Pittsburg, Pa.—The contract for constructing a filtration plant was awarded March 16 to the T. A. Gillespie Co. of New York City and Pittsburg, whose total bid of the contract was $5,469,000.

Menina, N. Y.—The contract for a municipal works plant was awarded as follows: Construction, L. J. Richardson & Co., Oswego, N. Y.; pipe and special castings, Charles Miller & Son Co., Utica, N. Y.; hydrants and valves, Eddy Valve Co., Waterford, N. Y.

BRIDGES.

Tillamook, Ore.—Bids are asked until April 10 for a bridge over North Nehalen River. Co. clk.

Newcastle, Ind.—Bids are asked until April 4 for constructing a steel bridge. County comrs.

Lafayette, Ind.—Plans are being pre-

pared for a bridge with concrete floor. G. H. Stevenson, co. clk.

Smithland, Ky.—Bids are asked until April 5 for a steel bridge over Phelps Creek. Thomas Evans, Co. Judge.

Warrentown, Mo.—Bids are asked until April 6 for a steel bridge over Charrette Creek. A. W. Wehmeyer.

Townsend, Mont.—Bids are asked until April 10 for a steel combination bridge over Missouri River. Wm. Schrinner, clk.

Dayton, Ohio.—Bids are asked until April 4 for constructing abutment walls and superstructure of bridge across Summitt-st. B. P. S.

Cleveland, Ohio.—Bids are asked until April 12 for building several steel bridges throughout the county. Julius C. Dorn, co. clk.

Janesville, Wis.—The question of issuing bonds for building a bridge across river at Racine-st. will be voted on April 4. A. E. Badger, cy. clk.

Bluffton, Ind. — Bids are asked until April 6 for an iron bridge over Salamony River and for constructing fifteen concrete bridges. C. S. Brineman, co. audt.

Anoka, Minn.—Bids are asked until April 7 for constructing fifty feet of new approaches with concrete or stone abutments at St. Frances-st., over Rumm River.

Springfield, Mass.—Bids are asked until April 8 for metal work of highway bridge over Connecticut river between Chicopee and West Springfield. Robt. O. Morris, co. clk.

Denver, Colo.—Bids will be asked soon, bidders to submit their own designs, for a two-span reinforced concrete bridge over South Platte river, at Colfax-ave., with 40-ft. roadway and 10-ft. sidewalks on either side. Length 140 ft. B. P. W.

Indianapolis, Ind.—Bids are asked until April 25 for constructing the following: Bridge over Buck creek, Franklin twp.; grading approaches to bridge over Buck Creek, Franklin twp.; bridge over Lick Creek, Perry twp.; bridge over canal, Central-ave., Washington twp.; bridge over Crooked Creek, Washington twp.; grading approaches to bridge, Crooked Creek, Washington twp. Bids are asked until April. Buckle plates for completion of bridge over White river on W. Washington-st. John McGregor, co. comrs.

STREET LIGHTING.

Arcanum, O.—This town voted to issue bonds for an electric plant.

Morristown, Minn.—City Council has decided to construct a gas plant.

Pottsdam, N. Y.—The question of municipal lighting will be voted on.

Cookville, Tenn.—Bids are asked until April 15 for constructing an electric light plant.

Meridian, Miss.—Bids will be received in May for a 50-year franchise for a gas plant.

Ackerman, Miss.—The construction of an electric light plant is contemplated. T. F. McGee interested.

Tekamah, Neb.—This town voted to issue bonds for installing a municipal electric light plant.

Waverly, Kas.—Bids are asked until April 3 for constructing an electric light plant. W. H. Williams, cy. clk.

New Albany, Miss.—Bids are asked until April 6 (change of date) for installing an electric light plant.

Lake Charles, La.—The question of issuing bonds for building a municipal electric plant will be voted on in April.

Lyons, Kas.—A twenty-year franchise has been granted the Lyons Electric Company to construct an electric and power plant.

Freeport, L. I., New York.—A franchise has been granted the South Shore Gas Company for building a gas plant in this village.

Ligonier, Ind.—Bids are asked until April 27 for lighting this city by electricity for a term of six years. Fred H. Green, Mayor.

Ocean Park, Cal.—Bids will be received April 10 for the purchase of a franchise to lay gas pipes. Dana Burke, pres. bd. trustees.

Glenwod, Ia.—Bids are asked until April 4 for const. a power station at the institution for feeble minded children. Board of State Institutions, Des Moines.

Modesto, Cal.—Bids for franchise will be received until May 2 to const. poles and string wires along the county roads for transmitting electric current. J. B. Doyle, co. clk.

Baltimore, Md.—The contract for furnishing and maintaining electric arc lamps for the streets and other public places was awarded March 15 to the Consolidated Gas, Electric Light & Power Company for 5 years at $67.49 per lamp per year.

Chicago, Ill.—Bids are asked until April 12 for const. the power house of the Lockport Power Development, near Lockport, Ill. The power house is to be a concrete structure. Zina R. Carter, prest. bd. trustees sanitary district.

GARBAGE DISPOSAL, STREET CLEANING AND SPRINKLING.

Superior, Wis.—City Council will purchase soon three large street sprinklers.

New Orleans, La.—Bids are asked until April 3 for the construction of one, two and three garbage boats for this city. Charles R. Kennedy Co.

Jamaica, L. I.—The contract for a new garbage crematory plant for the Fourth Ward of Queens Borough, was awarded to William Knowlan for $24,950.

Butler, Pa.—Special.—James A. McDowell says this city will erect a furnace soon. Plans and specifications not yet adopted. J. C. Say, chmn. com.

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